

**UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
NORTHERN DIVISION**

LATOYA BROWN; LAWRENCE BLACKMON;
HERBERT ANTHONY GREEN; KHADAFY
MANNING; QUINNETTA MANNING; MARVIN
MCFIELD; NICHOLAS SINGLETON; STEVEN
SMITH; BESSIE THOMAS; and BETTY JEAN
WILLIAMS TUCKER, individually and on behalf of a
class of all others similarly situated,

Plaintiffs,

v.

MADISON COUNTY, MISSISSIPPI; SHERIFF
RANDALL S. TUCKER, in his official capacity; and
MADISON COUNTY SHERIFF'S DEPUTIES JOHN
DOES #1 through #6, in their individual capacities,

Defendants.

Civil Action No.
3:17-cv-00347-WHB-LRA

**ORAL ARGUMENT
REQUESTED**

**PLAINTIFFS' RESPONSE IN OPPOSITION TO
DEFENDANTS' *DAUBERT* MOTION AND MOTION *IN LIMINE*
TO EXCLUDE THE TESTIMONY OF BRYAN RICCHETTI**

Plaintiffs Latoya Brown, Lawrence Blackmon, Khadafy Manning, Quinnetta Manning, Nicholas Singleton, Steven Smith, Bessie Thomas and Betty Jean Williams Tucker ("Plaintiffs") respectfully submit this memorandum in opposition to Defendants' *Daubert* Motion and Motion *In Limine* to Exclude the Testimony of Bryan Ricchetti (ECF No. 270) ("Defendants' Motion") in this civil rights action brought against defendants Madison County, Mississippi ("Madison County") and Sheriff Randall Tucker, sued herein in his official capacity ("Sheriff Tucker," and

with Madison County, “Defendants”). Pursuant to L.U. Civ. R. 7(b)(6)(A), Plaintiffs respectfully request oral argument on the Motion.¹

1. Dr. Ricchetti’s statistical analysis provides strong evidence that the Madison County Sheriff’s Department (“MCSD”) engages in racial discrimination by disproportionately conducting roadblocks in Black neighborhoods. Using widely accepted methodology, Dr. Ricchetti conducted a series of statistical analyses based on MCSD roadblock locations, DUIs, traffic violations, the Black population percentage of census tracts, and socioeconomic data. Dr. Ricchetti identified a statistically significant relationship between the frequency of MCSD roadblocks and Black population percentage. Dr. Ricchetti’s findings provide evidence that MCSD unconstitutionally takes race into account when selecting roadblock locations.

2. Defendants’ criticisms of Dr. Ricchetti’s statistical analysis are based on misunderstandings, mischaracterizations, and mere disagreement with Dr. Ricchetti’s conclusions. Defendants’ Motion therefore does not present a valid or sufficient basis for excluding Dr. Ricchetti’s expert testimony. *See, e.g. Graves ex rel. W.A.G. v. Toyota Motor Corp.*, No. 2:09cv169KS-MTP, 2011 WL 4625403, *7 (S.D. Miss. Oct. 3, 2011); *Kelly v. Paschall*, No. W-03-CA-179, 2005 WL 5988658, at *4 (W.D. Tex. Apr. 19, 2005). Defendants’ Motion should be denied.

3. *First*, Defendants argue that Dr. Ricchetti’s statistical analysis is flawed because he allegedly did not use reliable methods to geocode the locations of MCSD roadblocks and because the data MCSD itself produced is unreliable. Defendants’ allegations of geocoding-related errors are unfounded and rebutted by Plaintiffs’ own geocoding expert, Dr. Patricia

¹ Because the issues presented by this Motion overlap with the issues presented by Plaintiffs’ pending Motion for Class Certification (ECF No. 231), Plaintiffs request that argument on the instant Motion should be held jointly with argument on Plaintiffs’ Motion for Class Certification.

Frontiera. Defendants have also failed to provide any support for their assertions that the alleged geocoding-related errors affected Dr. Ricchetti's statistical analysis. To the contrary, basic statistical principles—confirmed by Dr. Ricchetti's own tests—demonstrate that geocoding-related errors, if any, do not change or cast into doubt Dr. Ricchetti's findings.

4. *Second*, Defendants claim that Dr. Ricchetti “relied on an arbitrary threshold for separating Madison County’s census tracts into White and Black categories.” This critique is based on a misunderstanding of the nature and purpose of Dr. Ricchetti’s descriptive analysis, which is the standard and generally accepted practice of providing a summary overview of relevant patterns in conjunction with a formal statistical analysis (in this case, Dr. Ricchetti’s regression model). None of Dr. Ricchetti’s statistical findings depend on separating Madison County’s census tracts by any particular “threshold.”

5. *Finally*, Defendants claim that Dr. Ricchetti’s multiple regression model improperly relies on census demographics and does not adequately account for variables in traffic behavior that might explain differences in roadblock frequencies. As Dr. Ricchetti explained in his first report, Dr. Ricchetti’s model has direct controls for relevant traffic behavior (DUIs and traffic citations). Dr. Ricchetti’s use of census data, *in addition to* direct controls for traffic behavior, is a widely accepted methodology that is regularly used in statistical analysis of racial discrimination.

6. In sum, Dr. Ricchetti’s report is based on sufficient data and reliably applies robust, widely accepted statistical methodology. His findings provide strong evidence that MCSD is engaged in discriminatory policing practices.

7. For the foregoing reasons, and as described in greater detail in Plaintiffs’ Memorandum of Law in Opposition to Defendants’ *Daubert* Motion and Motion *In Limine* to

Exclude the Testimony of Bryan Ricchetti, the Court should deny Defendants' Motion.

8. In support of this response, Plaintiffs submit an accompanying Memorandum of Law, which is incorporated herein as if set forth in full, and the exhibits listed below:

Exhibit 1: Expert Report of Bryan Ricchetti, Ph.D. (March 13, 2018)

Exhibit 2: Rebuttal Expert Report of Bryan Ricchetti, Ph.D. (July 2, 2018)

Exhibit 3: Rebuttal Expert Report of Patricia Frontiera, Ph.D. (July 2, 2018)

Exhibit 4: Rebuttal Expert Report of Justin McCrary, Ph.D. (July 2, 2018)

Exhibit 5: Rebuttal Report of Dwight D. Steward, Ph.D. RE: Bryan Ricchetti, Ph.D. (May 8, 2018)

Exhibit 6: Rebuttal Report of William R. Funderburk (May 8, 2018)

Exhibit 7: Excerpts from the Deposition of Bryan Ricchetti, Ph.D. (April 6, 2018)

Exhibit 8: Excerpts from the Deposition of Dwight Steward, Ph.D.
(June 22, 2018)

Exhibit 9: Excerpts from the Deposition of William Funderburk (June 20, 2018)

WHEREFORE, PREMISES CONSIDERED, Plaintiffs respectfully submit that Defendants' *Daubert* Motion and Motion *In Limine* to Exclude the Testimony of Bryan Ricchetti should be denied.

Respectfully submitted this 2nd day of July, 2018.

By: /s/ Joshua Tom
Joshua Tom

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CERTIFICATE OF SERVICE

I hereby certify that on July 2, 2018, I caused the foregoing **PLAINTIFFS' RESPONSE IN OPPOSITION TO DEFENDANTS' DAUBERT MOTION AND MOTION *IN LIMINE* TO EXCLUDE THE TESTIMONY OF BRYAN RICCHETTI** to be electronically filed with the Clerk of the Court using the CM/ECF system, through which copies have been served to:

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EXHIBIT 1

**UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
JACKSON DIVISION**

LATOYA BROWN; LAWRENCE
BLACKMON; HERBERT ANTHONY
GREEN; KHADAFY MANNING;
QUINNETTA MANNING; MARVIN
MCFIELD; NICHOLAS SINGLETON;
STEVEN SMITH; BESSIE THOMAS; and
BETTY JEAN WILLIAMS TUCKER,
individually and on behalf of a class of all
others similarly situated,

Plaintiffs,

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MADISON COUNTY, MISSISSIPPI;
SHERIFF RANDALL S. TUCKER, in his
official capacity; and MADISON COUNTY
SHERIFF'S DEPUTIES JOHN DOES #1
through #6, in their individual capacities,

Defendants.

Civil Action No.

3:17-cv-00347-WHB-LRA

REPORT OF BRYAN RICCHETTI, Ph.D.

March 13, 2018

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1. QUALIFICATIONS

1. I am a Vice President at Cornerstone Research and Co-Head of Cornerstone's antitrust practice. Cornerstone Research is an economic and financial consulting firm with offices in Boston, Chicago, Los Angeles, Menlo Park, New York, San Francisco, Washington, and London. I joined Cornerstone Research in 2007, after completing my Ph.D. in Economics from Cornell University. I have seventeen years of professional experience analyzing economic data related to socioeconomic and demographic characteristics (including race) and economic outcomes.

2. During my time at Cornell (2003–2007), I served as an economist at the U.S. Census Bureau analyzing government data on demographic characteristics (including race) and labor market outcomes for the U.S. population. Prior to attending Cornell, I worked at MDRC (1999–2002), a public policy think tank in New York, NY, analyzing labor market outcomes of welfare recipients, with a focus on the effect of different demographic and human capital characteristics on labor market outcomes.

3. In my work as an economic consultant at Cornerstone Research (2007 to present), I have developed particular expertise in the application of economic and statistical methods to questions that arise in the context of litigation. I have consulted on numerous discrimination matters involving statistical analysis and summary of data regarding differences between different demographic groups (including race, gender, and age) and outcomes of interest.

4. As an expert witness, I have filed two expert reports in federal court addressing issues of discrimination: one matter involving claims of age discrimination and another matter assessing the relationship between the racial distribution of entry-level police and firefighters in a given community and the racial distribution of the qualified labor pool in that community.

5. I have spoken at American Bar Association (ABA) conferences on issues related to expert testimony and statistical analysis, including serving as the testifying expert in the mock trial at both the ABA Antitrust Spring Meetings (Spring 2015) and the ABA Antitrust Law & Economics Institute for Judges (Fall 2015). I have also authored several articles that address the use of economic and statistical analysis in litigation contexts. For example, I was a co-author of the

chapter “Applying Econometrics to Assess Market Definition and Market Power” in the ABA Antitrust Section’s handbook *Econometrics: Legal, Practical, and Technical Issues*.

6. My CV is attached as Appendix A to this report. My CV contains the list of my prior testimony for the last four years. I am providing my services in this matter on a pro bono basis.

2. ASSIGNMENT AND SUMMARY OF FINDINGS

2.1. Assignment

7. I have been asked by Simpson Thacher & Bartlett LLP, the American Civil Liberties Union of Mississippi Foundation, and the American Civil Liberties Union Foundation, Counsel for Plaintiffs in this action,¹ to review the available data on the locations and frequency of roadblocks implemented by the Madison County Sheriff’s Department (“MCSD”) in Madison County. Counsel for the Plaintiffs have also asked me to assess whether there is a relationship between the location and frequency of the roadblocks and the percentage of the population that is Black in communities where roadblocks are set up.

8. As part of my work in this matter, a team working under my supervision at Cornerstone Research has reviewed and analyzed a set of data sources produced by the MCSD in this matter that track relevant information related to roadblocks and traffic violations in Madison County. My team has also collected data from the U.S. Census Bureau that measures socioeconomic and demographic characteristics for each census tract within Madison County. I detail these data sources in Section 3 below.

9. I have also reviewed a set of relevant documents in this case, including the Complaint and the Defendants’ Answer to the Complaint. Appendix B to this

¹ Class Action Complaint for Declaratory and Injunctive Relief and Individual Damages, *Latoya Brown; Lawrence Blackmon; Herbert Anthony Green; Khadafy Manning; Quinnetta Manning; Marvin McField; Nicholas Singleton; Steven Smith; Bessie Thomas; and Betty Jean Williams Tucker, individually and on behalf of a class of all others similarly situated, v. Madison County, Mississippi; Sheriff Randall S. Tucker, in his official capacity; and Madison County Sheriff’s Deputies John Does #1 through #6, in their individual capacities*, CIVIL ACTION NO. 3:17-cv-347 WHB-LRA, filed May 8, 2017 (“Complaint”).

report provides a list of the data and documents that I considered in reaching the opinions summarized in this report.

2.2. Summary of Findings

10. Based on my review of the aforementioned data sources, I have reached the following conclusions:

- The available data indicate that the MCSD implemented roadblocks at a higher rate in census tracts with a higher percentage of Black residents in Madison County. For example, there are 21 different census tracts within Madison County, each of which had a different percentage of the population that was Black over the period for which I have roadblock data (2012–2017). These 21 different census tracts allow me to examine how the frequency of roadblocks varies with the percentage of the population that is Black. As I discuss below, the racial breakdown of the 21 census tracts is split fairly cleanly into two groups—in 11 of the 21 tracts 28% or less of the population was Black during the period 2012–2017, while in the other 10 tracts 46% or more of the population was Black during the period 2012–2017. On average, the first 11 tracts were 17.6% Black and the other 10 tracts were 66.0% Black from 2012–2017.

As I show below in Section 4, from 2012–2017 there were 14 roadblocks implemented per 1,000 residents in the 11 census tracts with the lowest percentage of Black residents (17.6% Black on average) compared to 28 roadblocks implemented per 1,000 residents in the 10 census tracts with the highest percentage of Black residents (66.0% Black on average). In other words, the number of roadblocks per person in the census tracts with a substantially larger Black percentage of the population was twice the number of roadblocks per 1,000 residents in census tracts with a relatively low Black percentage of the population. As I also show below, geocoding analysis of the locations of roadblocks corroborates this fact, showing clustering of roadblocks in substantially Black communities.

- Additionally, the differences in the rates of roadblocks in communities with a higher percentage of Black residents are not fully explained by differences in the frequency of DUI arrests and traffic violations (arrests

and citations) issued by the MCSD. For example, Defendants contend that regulating drunken driving and traffic violations are relevant criteria used in deciding where to implement a roadblock. Although Defendants' data indicate that there are, on average, higher rates of DUI arrests and traffic violations in census tracts with a higher percentage of Black residents, I show below that such criteria do not fully explain the higher rates of roadblocks in these census tracts. For example, from 2012–2017 the rate of roadblocks per 100 DUI arrests in the 10 tracts with the highest Black percentage of the population was 41% higher than in the 11 census tracts with the lowest percentage of Black residents. In other words, even for a given level of DUI arrests, there were more roadblocks in census tracts with a higher Black percentage. Additionally the rate of roadblocks per 100 traffic violations (arrests and citations) in the 10 tracts with the highest Black percentage of the population was 40% higher than in the other 11 census tracts.

- More formal statistical analysis supports the conclusions above. Specifically, I use multiple regression analysis in order to control for differences in traffic behavior and socioeconomic factors across census tracts in Madison County (such as frequency of DUI arrests, traffic citations and arrests, vehicle ownership, income, unemployment, and age). When conducting this analysis, I continue to find a statistically significant and positive correlation between the rate of roadblocks and the percentage of the population that is Black. In other words, my analysis incorporates the fact that communities with a higher percentage of Black residents have, on average, other characteristics that are predictive of differences in traffic behavior, such as higher rates of DUI arrests and traffic arrests and citations, lower income, higher unemployment, and younger populations. However, my analysis shows that even after accounting for these factors there remains an unexplained difference in the frequency of roadblocks in communities that have a higher percentage of Black residents relative to communities with a higher percentage of white residents.

3. METHODOLOGY AND DATA

11. In this section, I summarize the methodology I employ in my analysis of the available roadblock data. I first provide a brief overview of factors identified in the record that the MCSD contends it considers when implementing a roadblock. I then offer a description of common statistical methodology used in assessing claims of discrimination, and of how that methodology fits into the broader literature on statistical analysis of differences in policing activity across race. I also provide a detailed summary of the data I rely on in my analysis, and how I use that data to construct relevant control variables included in my regression model.

3.1. The MCSD's stated roadblock policy

12. In analyzing whether roadblocks in Madison County are more frequently placed in Black communities, it is relevant to assess the factors that MCSD contends it considers in placing roadblocks. In documents produced in this case, Defendants have identified factors that they claim are relevant in deciding where to place roadblocks.

13. In their response to the Complaint, Defendants state, “all roadblocks conducted by the Madison County Sheriff’s Department are conducted pursuant to the Department’s Sobriety Checkpoint Guidelines.”² Additionally, when asked to “identify all criteria used for selecting locations for roadblocks/checkpoints” by the Plaintiffs, Defendants responded as follows:

“Some of the criteria used while selecting roadblock/checkpoint locations are traffic complaints, requests by businesses or other entities for safety, and particular intersections where impaired drivers may be expected to travel. Another criteria is that the roadblocks/checkpoints

² Answer and Affirmative Defenses of Defendants, Madison County, Mississippi and Sheriff Randall C. Tucker, In His Official Capacity, *Latoya Brown; Lawrence Blackmon; Herbert Anthony Green; Khadafy Manning; Quinnetta Manning; Marvin McField; Nicholas Singleton; Steven Smith; Bessie Thomas; and Betty Jean Williams Tucker, individually and on Behalf of a class of all others similarly situated, v. Madison County, Mississippi; Sheriff Randall S. Tucker, in his official capacity; and Madison County Sheriff’s Deputies John Does #1 through #6, in their individual capacities*, CIVIL ACTION NO. 3:17-cv-347 WHB LRA, dated June 29, 2017 (“Defendants’ Response to the Complaint”), ¶ 140.

locations be spread throughout Madison County and not concentrated in certain areas. No formal system of weighting or priority is used.”³

14. Defendants thus contend that DUI frequency and concerns for safety related to traffic activity are relevant considerations for the MCSD in deciding where to place roadblocks. As a result, I incorporate measures of DUI arrests and traffic citations and arrests into my analysis of roadblocks.

3.2. Empirical methodology for assessing claims of discrimination

15. As noted above, my analysis in this report seeks to test whether the frequency of roadblocks in communities with substantial percentages of Black residents differs from the frequency of roadblocks in substantially white communities during the time period for which data is available, controlling for non-race factors that can affect the location of a roadblock. By controlling for such non-race factors, my analysis can help assess whether any differences in roadblock frequency can be explained by differences across communities in factors other than race that are predictive of differences in traffic behavior.

16. My analysis in this report relies on a statistical technique called multiple regression analysis. Multiple regression analysis is a widely accepted and common statistical technique in both academia and litigation.⁴ Courts have relied on multiple regression analysis in a variety of discrimination matters. For example, the Federal Judicial Center’s *Reference Manual for Scientific Evidence* (a document designed to aid federal judges in assessing scientific evidence)

³ Response by Defendants, Madison County, Madison County, Mississippi and Sherriff Randall Tucker, in His official capacity, to Plaintiffs’ First Set of Interrogatories, *Latoya Brown; Lawrence Blackmon; Herbert Anthony Green; Khadafy Manning; Quinnetta Manning; Marvin McField; Nicholas Singleton; Steven Smith; Bessie Thomas; and Betty Jean Williams Tucker, individually and on Behalf of a class of all others similarly situated, v. Madison County, Mississippi; Sheriff Randall S. Tucker, in his official capacity; and Madison County Sheriff’s Deputies John Does #1 through #6, in their individual capacities*, CIVIL ACTION NO. 3:17-cv-347 WHB LRA, dated October 20, 2017, ¶ 23.

⁴ Rubinfeld, Daniel L., “Reference Guide on Multiple Regression,” *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, The National Academies Press, Washington, D.C., 2011, pp. 305–306 (“Multiple regression analysis is a statistical tool used to understand the relationship between or among two or more variables.... Over the past several decades, the use of multiple regression analysis in court has grown widely.”); Greene, William H., *Econometric Analysis*, 6th Edition, Pearson Prentice Hall, 2008, pp. 8–10 (“The linear regression model is the single most useful tool in the econometrician’s toolkit. ... The multiple linear regression model is used to study the relationship between a dependent variable and one or more independent variables. ... One of the most useful aspects of the multiple regression model is its ability to identify the independent effects of a set of variables on a dependent variable.”).

dedicates an entire chapter to multiple regression analysis, including applications to questions of discrimination.⁵

17. Regression analysis is a useful tool to assess claims of discrimination because it allows a researcher to control for relevant factors in the available data that affect the outcome of interest in order to more reliably isolate the effect of the variable on which there is alleged discrimination (e.g., race, gender, age). A large body of academic literature exploring concerns of potential discrimination in labor markets details these methods.⁶ The *Reference Manual on Scientific Evidence* describes the importance of controlling for other factors as follows:

“A correlation between two variables does not imply that one event causes the second. Therefore, in making causal inferences, it is important to avoid spurious correlation. Spurious correlation arises when two variables are closely related but bear no causal relationship because they are both caused by a third, unexamined variable. For example, there might be a negative correlation between the age of certain skilled employees of a computer company and their salaries. One should not conclude from this correlation that the employer has necessarily discriminated against the employees on the basis of their age. A third, unexamined variable, such as the level of the employees’ technological skills, could explain differences in productivity and, consequently, differences in salary.”⁷

18. There is also a body of research literature focused on the specific question of differential policing and policing outcomes across race. That literature also emphasizes the importance of controlling for relevant, non-race factors when

⁵ Rubinfeld, Daniel L., “Reference Guide on Multiple Regression,” *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, The National Academies Press, Washington, D.C., 2011, pp. 305–307 (“Regression analysis has been used most frequently in cases of sex and race discrimination, antitrust violations, and cases involving class certification.”).

⁶ See, for example, Altonji, Joseph G., and Rebecca M. Blank, “Race and Gender in the Labor Market,” Ashenfelter, Orley David C., Card, (Eds.), *Handbook of Labor Economics*, 3, 1999; Blau, Francine D., and Lawrence M. Kahn, “Gender Differences in Pay,” *The Journal of Economic Perspectives*, 14(4), 2000, pp. 75–99; Bertrand, Marianne, “New Perspectives on Gender,” *Handbook of Labor Economics*, 4b, 2010.

⁷ Rubinfeld, Daniel L., “Reference Guide on Multiple Regression,” *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, The National Academies Press, Washington, D.C., 2011, p. 309.

assessing claims of racial profiling or bias by police. For example, one study funded by the U.S. Department of Justice to help law enforcement officials and researchers better understand how to analyze data on race and vehicle stops⁸ notes “the strongest research methodologies will address the alternative hypothesis that racial/ethnic groups are not equivalent in the nature and extent of their traffic law-violating behavior.”⁹

19. Another paper, which summarizes common statistical methods used for analyzing policing data, discusses the importance of controlling for “driving behavior that may be important sources for police decision-making, such as the likelihood of speeding, weaving through traffic, and driving slower than usual,”¹⁰ when analyzing traffic violations across race.

20. As I explain in Section 3.3 below, I am able to account for such concerns in my analysis in this report because I have access to detailed data that tracks each individual traffic arrest and citation by location within Madison County. Using such information, I can construct control variables that measure the frequency of DUI arrests and other traffic violations (arrests and citations) in order to assess how such violations vary across geographic areas with large differences in the percentage of Black residents.

3.3. Summary of available data and control variables for analysis

21. I rely on a set of different data sources produced in this case that track roadblocks and traffic violations in Madison County, as well as publicly available U.S. Census data. Below is a detailed summary of the data sources analyzed, and how I use the data sources to develop the key inputs into my empirical analysis.

⁸ Fridell, Lorie, “By The Numbers: A Guide for Analyzing Race Data from Vehicle Stops,” Police Executive Research Forum, 2004, p. ix (“*By the Numbers* is a detailed ‘how to’ guide for analyzing race data from vehicle stops. It provides a social science framework for understanding the challenges of trying to measure racial bias in policing and presents an array of methods for law enforcement professionals, researchers and other stakeholders to consider when interpreting the vehicle-stop data.”)

⁹ Fridell, Lorie, “By The Numbers: A Guide for Analyzing Race Data from Vehicle Stops,” Police Executive Research Forum, 2004, p. 22.

¹⁰ Ridgeway, Greg, and John MacDonald, “Methods for Assessing Racially Biased Policing,” *Race, Ethnicity, and Policing: New and Essential Readings, Infrastructure, Safety, and Environment*, NYU Press, 2010, p. 5.

3.3.1. Data on the date and location of roadblocks

22. Data on the dates and addresses of roadblocks set up by MCSD from January 1, 2012–December 20, 2017 come from three sources of data produced in this litigation by Defendants: computer-aided dispatch (“CAD”) records, a handwritten list of roadblocks conducted by the MCSD, and incident reports.

- The CAD roadblock data are the subset of all dispatch data where the “Description” field contains the value “Road Block” (“CAD Roadblocks”). These data provide incident number, date, address, and city fields for each roadblock.¹¹ I use these data as the primary source of roadblocks.
- I also run a sensitivity analysis that incorporates roadblocks reflected on a handwritten list of dates, start times, end times, and locations that I understand to be roadblocks (“Handwritten Roadblocks”) that was produced by Defendants.¹² I have been informed by Counsel that these roadblocks were set up as part of a state program to monitor for DUI incidents. As I discuss below, the Handwritten Roadblocks are incorporated as additional data points in sensitivities of my main results to the extent they do not appear in the list of CAD Roadblocks.
- For a second sensitivity analysis, roadblock data are also imputed from a manual review of incident reports for arrests made at roadblocks that I understand has been undertaken by Counsel for the Plaintiffs (“Additional Roadblocks”). The incident reports provide name, race, date, time, location, and deputy information for these arrests.¹³ The dates and locations of Additional Roadblocks do not appear in either the list of CAD Roadblocks or the list of Handwritten Roadblocks.

¹¹ “Master CAD Report – To Be Produced.csv”

¹² “Roadblock Locations (Handwritten).xlsx”

¹³ “Unlisted Roadblocks.xlsx”

- CAD Roadblocks account for 81.6% of the roadblock observations in the three data sources I analyze.

23. The data from these three sources are combined into a single dataset including date and address fields. Each roadblock is assigned to a census tract in Madison County based on its geographic coordinates.¹⁴ I then define a unique roadblock as a roadblock in a given location on a given day, and then count the total roadblocks by year at the census tract level in order to create a dataset of the frequency of roadblocks at the census tract level by year for the years 2012–2017. I calculate this sum four ways: (1) with only CAD Roadblocks, (2) with CAD Roadblocks plus Handwritten Roadblocks, (3) with CAD Roadblocks plus Additional Roadblocks, and (4) with roadblocks from all three sources. The number of roadblocks per capita is then calculated for each of these approaches by dividing the total number of roadblocks in a given census tract and year by the population of the census tract.

3.3.2. *Data on traffic violations by location*

24. As discussed above, it is important to include control variables in my analysis that can directly measure differences in the underlying traffic behavior between different communities in Madison County for two reasons: (1) the research literature assessing the role of race in traffic stops emphasizes the importance of controlling for differential traffic behavior; and (2) the MCSD indicates that DUIs and traffic safety are factors in implementing roadblocks.

25. I understand that the CAD data produced by the Defendants includes all incidents in which MCSD officers are involved that are called into central dispatch, not only those relating to roadblocks.¹⁵ As a result, these data may be

¹⁴ I convert the addresses into longitude and latitude coordinates. Only roadblocks for which an accurate set of coordinates can be determined are used in my analysis. This removes 14.9% of the roadblocks listed in the three data sources from my analysis.

¹⁵ Defendants' Memorandum of Authorities in Opposition to Plaintiffs' Motion to Compel, *Latoya Brown; Lawrence Blackmon; Herbert Anthony Green; Khadafy Manning; Quinnetta Manning; Marvin McField; Nicholas Singleton; Steven Smith; Bessie Thomas; and Betty Jean Williams Tucker, individually and on behalf of a class of all other similarly situated, v. Madison County, Mississippi; Sheriff Randall C. Tucker, in his official capacity; and Madison County Sheriff's Deputies John Does #1 through #6, in their individual capacities*, CIVIL ACTION NO. 3:17-cv-347 WHB LRA, dated November 3, 2017 ("Memorandum of Authorities") broadly describes the contents of the CAD database. Defendants have represented that the CAD data include information on roadblocks, traffic stops, and other law enforcement encounters. Defendants have also represented that "[w]henver an incident is brought to the attention of a dispatcher in the Sheriff's Department, that information goes into the CAD database and is assigned an incident number." Memorandum of Authorities, p. 2.

used to construct control variables such as those described above. These data cover the period from January 1, 2012–December 20, 2017. They include date and address fields; times for when dispatch received a call regarding an incident; when an officer was dispatched; when an officer arrived and when a stop was cleared; a field containing a code signifying how the incident was resolved (e.g., in arrest, citation, etc.); and a field indicating the type of violation. These data do not include race information.

26. In order to include control variables for traffic behavior, I construct two variables from the CAD data. One accounts for the prevalence of DUI arrests per census tract,¹⁶ and the other accounts for the prevalence of traffic violations per census tract, including arrests and citations issued.¹⁷

3.3.3. *Race and socioeconomic information by census tract*

27. The U.S. Census Bureau (“Census Bureau”) provides detailed annual data at *the census tract level* for key demographic and socioeconomic factors in my analysis, including race, population, income, employment, age, and vehicle ownership. I collect data from the Census Bureau’s five year estimates from 2012–2016, in order to construct year-by-year measures of the variables described above.¹⁸ These data allow me to incorporate detailed information for each of the 21 census tracts in Madison County into my analysis.

28. I conduct my analysis at the census tract level for a few reasons. First, race data is not available for each individual police interaction in the CAD data, thus I cannot determine the race of the individuals stopped for any specific stop associated with a roadblock. Census tract data from the Census Bureau, on the other hand, does have race information.

¹⁶ Incidents included in DUI arrests are those in the CAD data that: 1) have a value for the variable “DISPO” of “ARREST MADE”; and 2) have a value for the variable “DESCRIPTION” of “INTOXICATED DRIVER (D.U.I.)”.

¹⁷ Incidents included in traffic arrests and citations are those in the CAD data that: 1) have a value for the variable “DISPO” of “ARREST MADE” or “CITATION ISSUED”; and 2) have a value for the variable “DESCRIPTION” of “INTOXICATED DRIVER (D.U.I.)”, “TRAFFIC STOP (V.T.O.)”, “STOPPING SUSPICIOUS VEHICLE”, “TRAFFIC OFFENSES”, “TRAFFIC-RECKLESS DRIVING”, “TRAFFIC-CARELESS DRIVING”, “TRAFFIC-DRAW RACING”, “TRAFFIC-OBSTRUCTING TRAFFIC”, “TRAFFIC-PASSING SCHOOL BUS”, or “TRAFFIC-OTHER TRAFFIC VIOLATIO”.

¹⁸ The estimate for each year is based on the preceding five years of data from the American Community Survey (ACS). For example, the estimate for 2012 is based on the ACS population estimates from 2008–2012. The five year estimate including 2017 has not yet been released, so I use the most recent five year estimate (2012–2016) for the census data in both 2016 and 2017.

29. Second, data on the traffic behavior of each individual citizen are not available. Therefore, it is not possible to perform an analysis that controls for traffic behavior at the individual level with the available data. On the other hand, using the crime data produced by the MCSD and available socioeconomic variables from the Census Bureau, I can construct measures of traffic behavior for each census tract.

30. Finally, because roadblocks are policing actions that should affect all motorists passing through a specific geographic area (rather than targeting a specific person), it is reasonable to analyze the placement of roadblocks within refined geographic sub-areas (like census tracts).

31. It is important to note that census tracts are a relatively fine categorization of geographic area. For example, there are 73,057 census tracts in the U.S., 664 in Mississippi and 21 in Madison County alone.¹⁹ This relatively fine categorization of geography is important for my analysis because it allows me to analyze how the frequency of roadblocks changes across numerous geographic sub-areas of Madison County that have substantially different racial breakdowns.

32. For example, Exhibit 1 shows the percentage of the population that is Black in each of the 21 census tracts in Madison County over the period 2012–2017. As is clear, there is large variation across the tracts with respect to the percentage of population that is Black—ranging from less than 11% to almost 90%.

¹⁹ “2010 Census – Census Tract Reference Map: Madison County, MS,” available at *U.S. Census Bureau*, https://www2.census.gov/geo/maps/dc10map/tract/st28_ms/c28089_madison/DC10CT_C28089_001.pdf; “2010 Census Tallies of Census Tracts, Block Groups & Blocks,” available at *U.S. Census Bureau*, <https://www.census.gov/geo/maps-data/data/tallies/tractblock.html>.

Exhibit 1

Average Percentage of the Population That is Black by Census Tract within Madison County (2012–2017)

Census Tract	Average Black Population Percentage
28089030101	10.7%
28089030202	10.9%
28089030203	11.6%
28089030301	11.6%
28089030206	13.0%
28089030204	14.7%
28089030104	16.5%
28089030205	17.9%
28089030107	18.0%
28089030201	18.6%
28089030400	28.0%
Average of Census Tracts with Low Black Population Percentage	
	17.6%
28089030105	46.2%
28089030106	47.6%
28089030302	49.3%
28089030700	58.4%
28089030800	59.6%
28089030108	65.6%
28089030900	69.5%
28089030600	83.7%
28089031000	84.0%
28089030500	89.5%
Average of Census Tracts with High Black Population Percentage	
	66.0%

Source: American Community Survey Five Year Estimates, U.S. Census Bureau

33. It is notable that the 21 census tracts are divided cleanly into two groups. Of the 21 census tracts, 11 have a relatively low percentage of Black residents (28% or lower), while 10 have a relatively high percentage of Black residents (46% or higher). On average, the percentage of Black residents in the first set of tracts is 17.6%, while it is 66.0% in the second set. This large variation in the percentage of the population that is Black across census tracts is central to my research

design because it allows me to examine how the frequency of roadblocks (and other factors related to roadblocks) differs across areas with large differences in the Black population.²⁰

34. As noted above, in addition to race, I also collect data from the Census Bureau on relevant socioeconomic and demographic variables, including population, median income, unemployment rate, percentage of population age 15–24, and vehicle ownership for each census tract. In Section 3 below, I include these variables in my regression model because they can help account for differences in relevant behavior that might not be fully accounted for by the direct measures of traffic behavior in the MCSD data. For example, vehicle ownership is a predictor of how frequently people drive. Age is also understood to be a direct correlate of traffic behavior—research indicates that younger drivers drive more recklessly on average.²¹ Income and unemployment are indicators for general economic well-being, which are associated with DUIs and levels of crime.²² As I discuss more below, income and unemployment can also serve as controls for the MCSD’s allocation of policing resources. As a result, disparities among these indicators across census tracts also provide potential explanations for differences in the rates of roadblocks across census tracts.

²⁰ Without large differences in race across geographic areas, we would not be able to compare differences in predominately Black communities and predominantly white communities. The variation across census tracts in Madison County allows for such comparisons. This type of research design, in which a single variable cleanly delineates two groups of people with and without a characteristic of interest, is a widely used research design in economic research that allows for quantification of the effect of that characteristic on relevant outcomes. See, for example, Angrist, Joshua, and Jörn-Steffen Pischke, “Undergraduate Econometrics Instruction: Through Our Classes, Darkly,” *Journal of Economic Perspectives*, 31(2), 2017, pp. 125–144.

²¹ Fridell, Lorie, “By The Numbers: A Guide for Analyzing Race Data from Vehicle Stops,” Police Executive Research Forum, 2004, pp. 19–22.

²² Chalfin, Aaron, and Justin McCrary, “Criminal Deterrence: A Review of the Literature,” *Journal of Economic Literature*, 55(1), 2017, pp 5–48; Impinen, Antti et al., “The Association between Social Determinants and Drunken Driving: A 15-Year Register-based Study of 81,125 Suspect,” *Alcohol and Alcoholism*, 46(6), 2011, pp. 721–728; Perrine, M.W., Raymond C. Peck, and James C. Fell, “Epidemiologic Perspectives on Drunk Driving,” *Surgeon General’s Workshop on Drunk Driving, Background Papers*, U.S. Department of Health and Human Services, 1988, pp. 35–76.

4. ANALYSIS OF THE LOCATION AND FREQUENCY OF ROADBLOCKS

35. In this section, I present the findings of my analysis of roadblocks. I start my analysis in Section 4.1 with a set of descriptive analyses that highlight the general patterns in the location and frequency of roadblocks across the 21 different census tracts in Madison County. I show that the frequency of roadblocks is generally higher in census tracts with a substantially higher percentage of Black residents.

36. In Section 4.2, I then present the findings of my regression analysis, where I formally test whether the frequency of roadblocks is higher in census tracts with a higher percentage of Black residents, controlling for other factors that are predictive of differences in traffic behavior. I find that, even after controlling for these factors, roadblocks are more frequent in census tracts with a higher percentage of the population that is Black.

4.1. Patterns of roadblocks across census tracts

37. As discussed above in Section 3, an important fact about Madison County is that the percentage of the population that is Black varies substantially across the 21 census tracts inside the county. This fact about Madison County allows me to examine whether the frequency of roadblocks is higher in areas within Madison County that have a substantially higher percentage of Black residents.

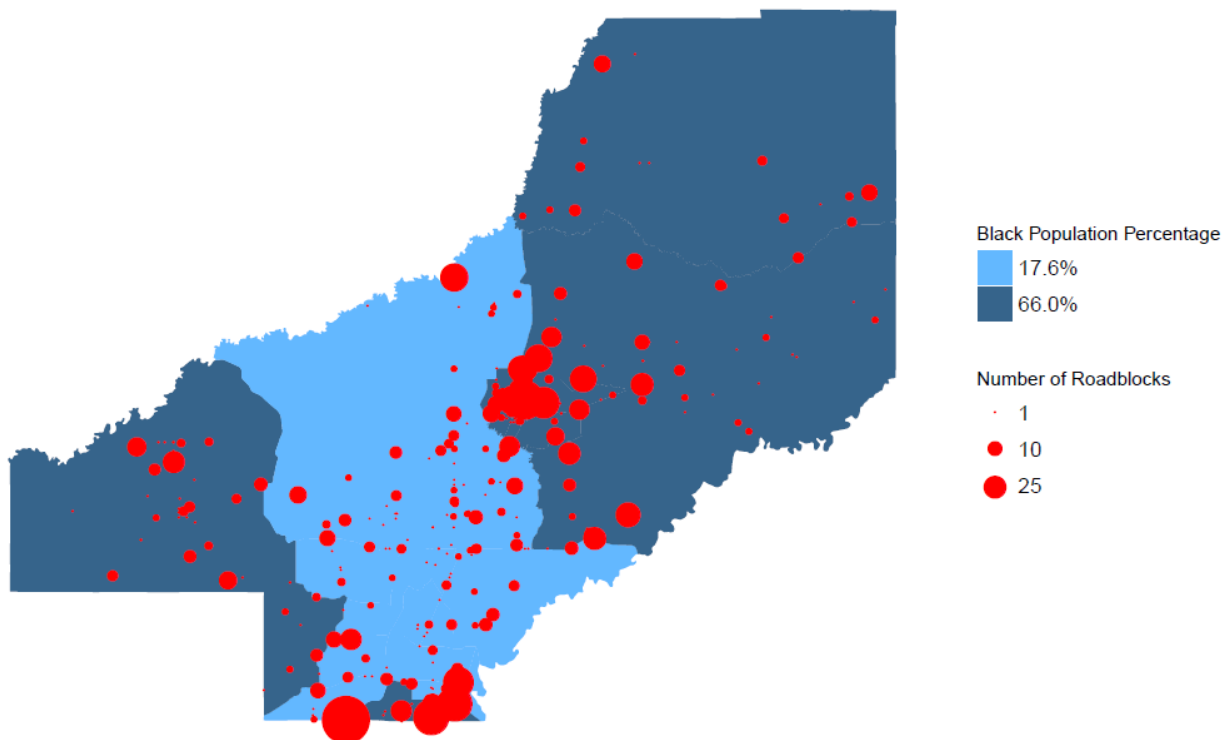
38. Exhibit 2 presents a map of the locations of the roadblocks in Madison County during the period 2012–2017, as well as the percentage of the population that is Black in each census tract. In total, there were 2,004 roadblocks established during this time period,²³ with at least one roadblock in each of the 21 different census tracts—ranging from as few as 7 in one census tract²⁴ to 275 in one of the census tracts in Canton in the center of the map.²⁵ Thus, the general geographic scope of the roadblocks extended to most areas of the county.

²³ These 2,004 unique roadblocks are composed of 1,697 CAD Roadblocks, 161 Handwritten Roadblocks, and 146 Additional Roadblocks, after removing duplicates based on date and location.

²⁴ Census tract 28089030202.

²⁵ Census tract 28089030600.

Exhibit 2

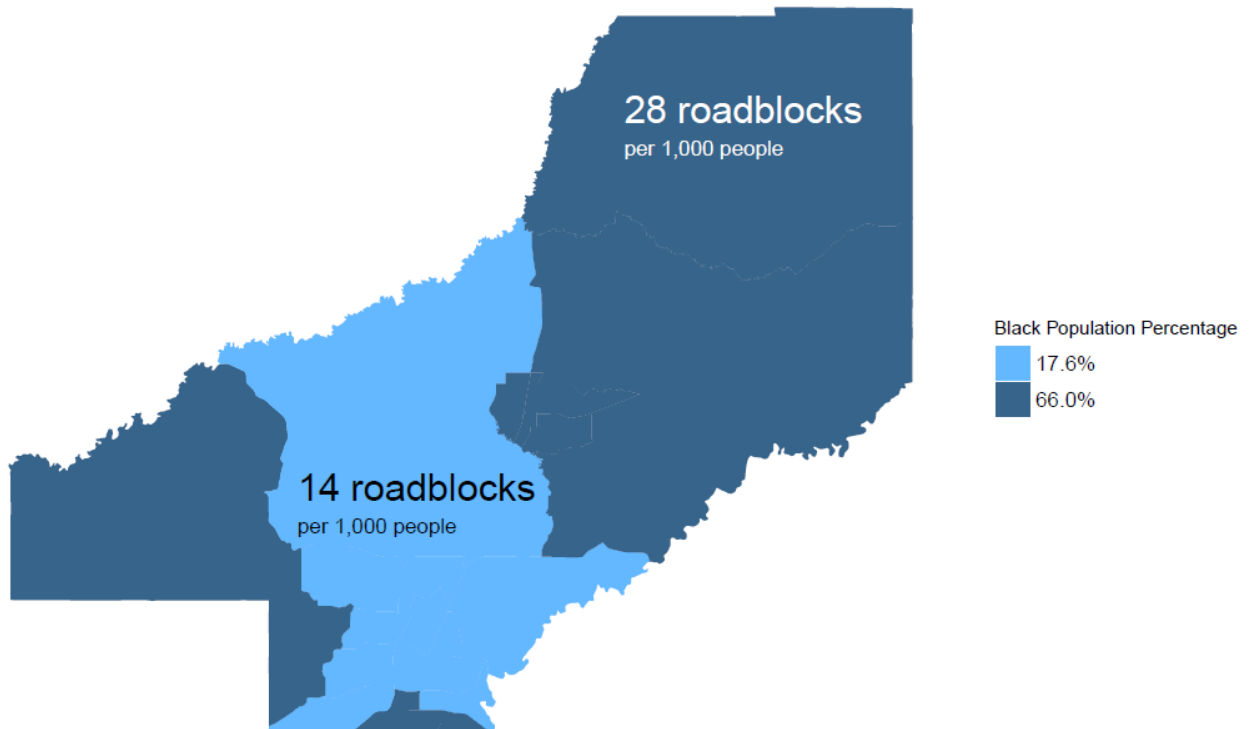
Location of Roadblocks by Census Tract within Madison County (2012–2017)

Source: American Community Survey Five Year Estimates, U.S. Census Bureau; Roadblock Locations (Handwritten).xlsx; Unlisted Roadblocks.xlsx; Master CAD Report – To Be Produced.csv

39. One thing that Exhibit 2 does not capture is the population of different census tracts. In Exhibit 3, I report the average number of roadblocks *per 1,000 citizens* for the 11 census tracts with the lowest percentage of Black residents (with an average of 17.6%) compared to the 10 census tracts with the highest percentage of Black residents (with an average of 66.0%). As seen in the exhibit, the number of roadblocks per 1,000 citizens in census tracts with a relatively low percentage of Black residents is 14, while for census tracts with a relatively high percentage of Black residents it is 28.²⁶ That is, the frequency of roadblocks is twice as high in census tracts with a relatively high percentage of Black residents as it is in census tracts with a relatively low percentage of Black residents.

²⁶ Total Population figures are from the 2012–2016 ACS Five Year Estimates. The Total Population for each group of census tracts is a weighted average across 2012 to 2017. Note that 2016 data is duplicated for 2017 because the 2017 ACS estimates have not yet been released.

Exhibit 3

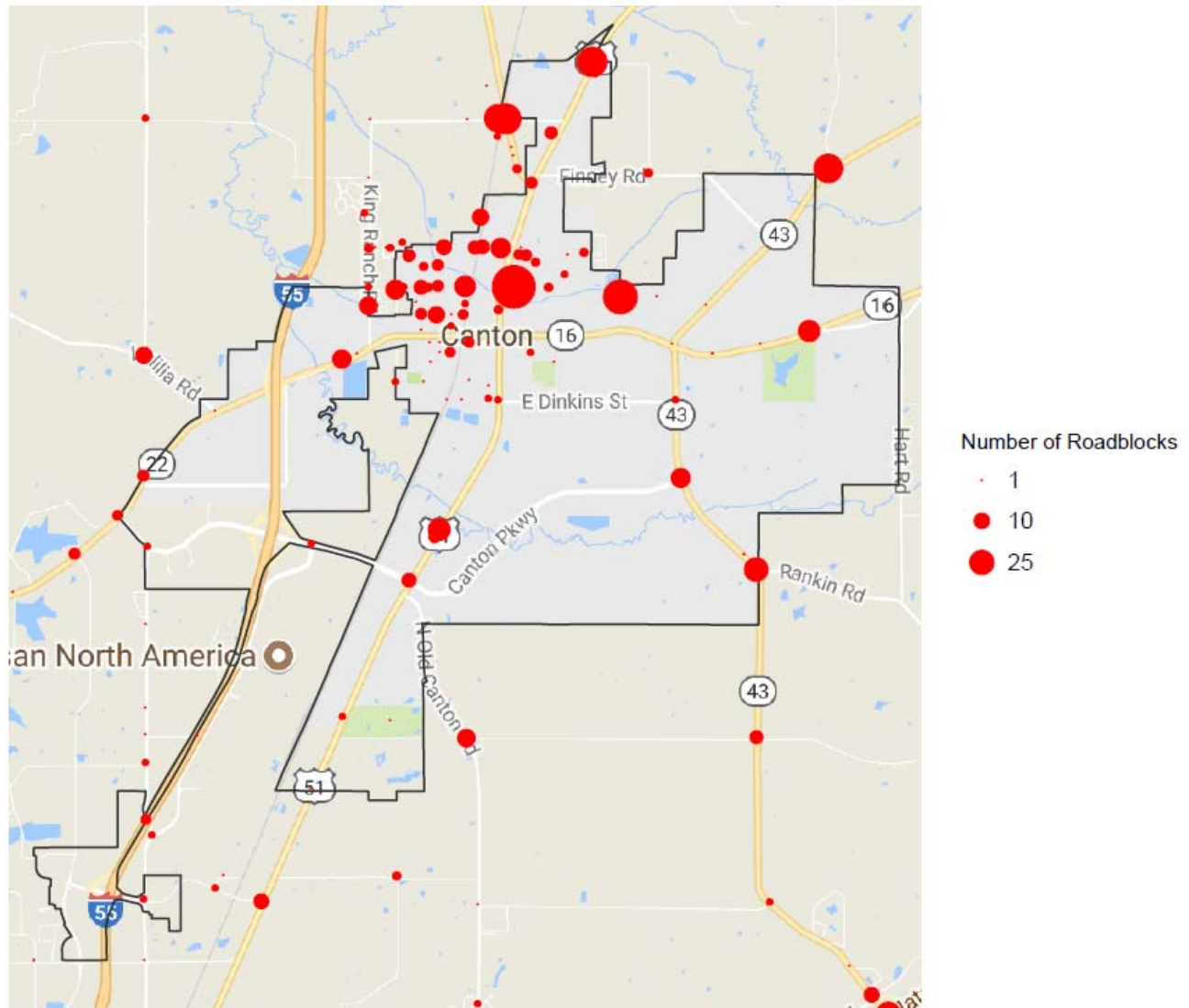
Frequency of Roadblocks by Racial Breakdown

Source: Master CAD Report – To Be Produced.csv; Roadblock Locations(Handwritten).xlsx; Unlisted Roadblocks.xlsx; American Community Survey (ACS) Five Year Estimates, U.S. Census Bureau

40. Exhibit 4 presents a map that zooms in on Canton, a city that is approximately 70.8% Black, according to the American Community Survey Five Year Estimate from 2016.²⁷ As is clear, the roadblocks are particularly clustered in a relatively small area of Canton towards the north.

²⁷ American Community Survey Five Year Estimates for All Places in Madison County, Mississippi, Demographic and Housing Estimates, 2016.

Exhibit 4

Roadblocks Located in Canton

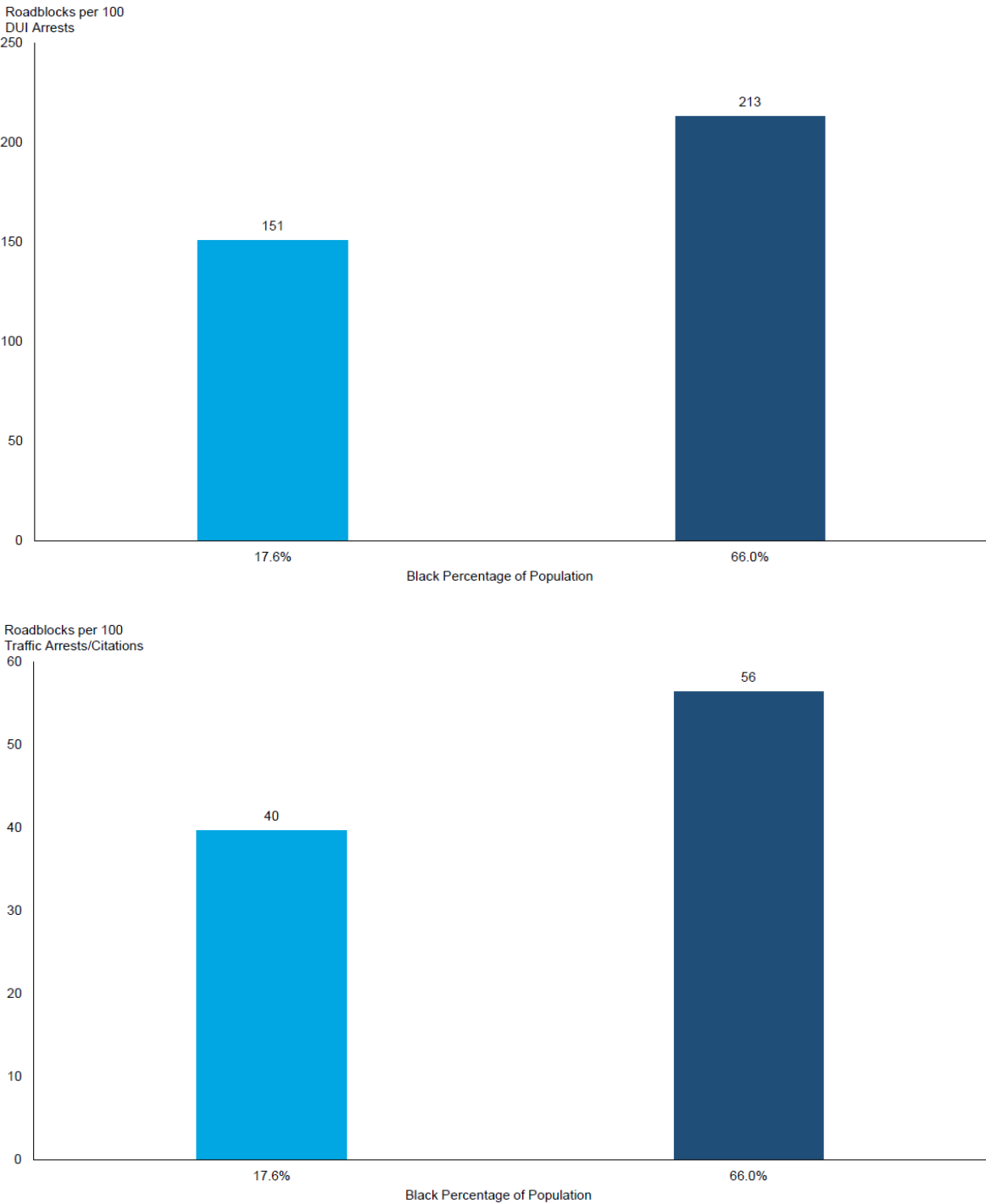
Source: American Community Survey Five Year Estimates, U.S. Census Bureau; Roadblock Locations (Handwritten).xlsx; Unlisted Roadblocks.xlsx; Master CAD Report – To Be Produced.csv; Google Maps

41. An important question is whether the higher rate of roadblocks in the different areas of Madison County might simply reflect different rates of unsafe traffic behavior. More roadblocks would be expected in some areas if there were higher rates of unsafe traffic behavior in those areas. Exhibit 5 presents two ways to think about that question. First, it presents the number of roadblocks *per* 100 DUI arrests for the 11 census tracts with the lowest percentage of Black residents (with an average of 17.6%) compared to the 10 census tracts with the highest

percentage of Black residents (with an average of 66.0%). As seen in the exhibit the number of roadblocks per 100 DUI arrests in census tracts with a relatively low percentage of Black residents is 151, while for census tracts with a relatively high percentage of Black residents it is 213, which is 41% higher.

42. Second, Exhibit 5 also presents the number of roadblocks *per* 100 traffic arrests and citations in the same two sets of census tracts. As seen in the exhibit, the number of roadblocks per 100 traffic arrests and citations in census tracts with a relatively low percentage of Black residents is 40, while for census tracts with a relatively high percentage of Black residents it is 56, which is 40% higher.

Exhibit 5
Roadblocks per 100 DUI and Traffic Violations by Racial Breakdown



Source: Master CAD Report - To Be Produced.csv; Roadblock Locations (Handwritten).xlsx; Unlisted Roadblocks.xlsx; American Community Survey Five Year Estimates, U.S. Census Bureau

43. In sum, the data indicate that: (a) roadblocks are more likely to be placed in census tracts with a higher percentage of Black residents, (b) roadblocks are sometimes clustered in large numbers in certain neighborhoods, and (c) the relatively higher frequency of roadblocks cannot be explained by a relatively higher number of DUI arrests or traffic arrests and citations.

4.2. Regression analysis

44. I now turn to my regression analysis, which uses multiple control variables to analyze the different frequency of roadblocks across census tracts. As detailed above in Section 3, regression analysis is a widely accepted method in both academic research and in litigation to analyze the effect of one variable (in this case, race) on another (in this case, frequency of roadblocks), while controlling for a set of control variables that also affect the variable of interest (frequency of roadblocks). In the current matter, I use regression analysis to better understand whether the relationship observed between the Black percentage of the population in Madison County and roadblocks across census tracts (discussed in Section 4.1 above) can be explained by differences between the census tracts in factors other than race that are predictive of differences in traffic behavior.

45. As discussed in Section 3 above, I include the following control variables in my regression model. The first four variables help control for differences in traffic behavior across the 21 census tracts, while the final two variables help control for economic status, which is correlated with DUIs, general crime/safety, and the allocation of police resources. The control variables I include are:

- DUI arrests per 1,000 people;
- Traffic arrests and citations per 1,000 people;
- Percentage of households with at least one vehicle;
- Percentage of population between ages 15-24;
- Median household income; and
- Unemployment rate.

46. Exhibit 6 presents the results of my regression analysis based on the CAD Roadblocks. It shows three different regressions. The first regression controls for DUI arrests and other factors from the census data, the second controls instead for traffic arrests and citations with other factors from the census data, and the third controls for both DUI arrests and traffic violations (arrests and citations) with

other factors from the census data. There are a few important things to note about the results.

- First, the effect of the percentage of Black residents is statistically significant and positive at less than the 5% level in all three models, which is the standard level of significance used in most academic research and in litigation.²⁸ These results indicate that, even after controlling for variables that are predictive of differences in traffic behavior, roadblocks are statistically significantly more likely to occur in areas with a higher percentage of Black residents.
- Second, DUI arrests are a very strong predictor of roadblocks. This can be seen by looking at the R-Squared of the three models. The R-squared is a statistic that tells us how well the control variables in the regression model explain the frequency of roadblocks across the different census tracts.²⁹ The model with DUI arrests and census variables as control variables has an R-squared of 0.646. What this means is that level of DUI arrests per 1,000 people in a given census tract explains 64.6% of the variation in roadblocks across census tracts, together with demographic controls. That is a relatively large R-squared,³⁰ and provides direct evidence that the model has significant explanatory power for roadblocks. The model with traffic arrests and citations and census variables, on the other hand, has an R-squared of less than half of the model with DUI arrests and census controls (0.293), which means that traffic arrests and citations with census controls explain roadblock frequency less than half as well as DUI arrests and census controls.

²⁸ Kaye, David H., and David A. Freedman, “Reference Guide on Statistics,” *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, The National Academies Press, Washington, D.C., p. 251; Rubinfeld, Daniel L., “Reference Guide on Multiple Regression,” *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, The National Academies Press, Washington, D.C., 2011, pp. 320–321.

²⁹ Rubinfeld, Daniel L., “Reference Guide on Multiple Regression,” *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, The National Academies Press, Washington, D.C., 2011, p. 316 (“In general, the more complete the explained relationship between the included explanatory variables and the dependent variable, the more precise the results.”).

³⁰ Greene, William H., *Econometric Analysis*, 6th Edition, Pearson Prentice Hall, 2008, p. 38.

Given this fact, the models with DUI arrests as a control are my preferred models.

- Third, the size of the coefficient on the percentage of Black residents (0.062) in my fullest model (the third column—including both DUI arrests and traffic arrests and citations as controls) is substantial. The following example helps explain what the coefficient signifies. Suppose that we compare an area that was 20% Black to one that was 80% Black. The coefficient means that there would be 3.73 more roadblocks per 1,000 citizens on average in the area that was 80% Black.³¹ To put that into context, the average census tract in Madison County had about 5,000 people per year during the relevant period. For such an average census tract, if the percentage of Black residents is 80% instead of 20%, my model predicts that there will be over 18 more roadblocks per year (3.73 more roadblocks per 1,000 people is 18.65 total roadblocks), or about 112 more roadblocks in total over the 6 years of data I analyze.

³¹ The effect of moving from an area that was 20% Black to one that was 80% Black in my model is equal to $(80-20)*0.06218$, which equals 3.7308.

Exhibit 6

Regression Results: Effect of Race on Frequency of Roadblocks, Controlling for Other Factors (2012–2017)

Variable	(1)	(2)	(3)
	With DUI Arrests	With Traffic Citations/Arrests	With DUI Arrests and Traffic Citations/Arrests
Black Percentage of Population	0.06492	0.05829	0.06218
standard error	0.01756	0.02486	0.01721
p-value	0.00033	0.02073	0.00044
Number of DUI Arrests Per 1,000 People	1.22070		1.38900
standard error	0.10390		0.12150
p-value	0.00000		0.00000
Number of Traffic Citations/Arrests Per 1,000 People		0.15220	-0.10300
standard error		0.04928	0.04075
p-value		0.00251	0.01281
Median Household Income (in Thousands)	0.03166	0.01685	0.02669
standard error	0.01588	0.02260	0.01566
p-value	0.04851	0.45750	0.09094
Unemployment Rate	-0.11910	-0.36860	-0.07771
standard error	0.07720	0.10540	0.07727
p-value	0.12550	0.00066	0.31660
Percentage of Households with At Least One Vehicle	-0.05640	-0.33580	-0.09574
standard error	0.07273	0.10080	0.07282
p-value	0.43960	0.00115	0.19120
Percentage of Population between Ages 15-24	-0.03368	-0.08256	-0.04544
standard error	0.04824	0.06838	0.04742
p-value	0.48640	0.22970	0.33980
Constant	2.58350	33.99400	7.05080
standard error	7.80860	10.80700	7.83940
p-value	0.74130	0.00209	0.37030
Observations	126	126	126
Adjusted R-Squared	0.646	0.293	0.662

Source: Master CAD Report - To Be Produced.csv; American Community Survey Five Year Estimates, U.S. Census Bureau

47. I have also run a set of sensitivity analyses to test whether my results are robust to the inclusion of the two sources of roadblocks outside of the CAD data, Handwritten Roadblocks and Additional Roadblocks. When I run my regression model including roadblocks from each of these two sources, I continue to find a

statistically significant and positive effect of the percentage of the population that is Black on the frequency of roadblocks.³²

48. I have also confirmed that my results are robust to restricting attention to subsets of the years for which data are available. At the request of Counsel, I specifically test whether my results are robust restricting attention to roadblocks that occurred in 2014 through 2017, and whether they are robust to restricting attention to roadblocks that occurred in only 2015 and 2016. I continue to find a statistically significant and positive effect of the percentage of the population that is Black on the number of roadblocks in these specifications.³³

4.3. A note on the data sample

49. I understand that Defendants contend that the MCSD focuses its policing resources only on the unincorporated areas of Madison County, and, to the extent they police within the incorporated areas, they focus disproportionately in cities that need more resources.³⁴ The available data on roadblocks are not consistent with this claim, as roadblocks are conducted by the MCSD in incorporated areas of Madison County.

50. Even if the MCSD did focus its policing in lower income areas of Madison County, this would not undermine my regression analysis because my key control variables (DUI arrests and traffic arrests and citations) capture policing activities by the MCSD. Thus, to the extent the MCSD's roadblocks are concentrated in certain lower income areas, my control variables would account for that fact because they also measure the MCSD's policing activities. In other words, if one were concerned that the higher rate of roadblocks in census tracts with a higher percentage of Black residents reflected the fact that the MCSD polices more heavily in those tracts, my model indicates that—even after accounting for the heavier policing activity in those areas—roadblocks are significantly more common in tracts with a higher percentage of Black residents.

³² See Appendix C.

³³ See Appendix C.

³⁴ Defendants' Response to the Complaint, ¶ 9.

51. Further, because my model includes controls for income and unemployment, it controls for the possibility that the MCSD's policing intensity varies with the income of a neighborhood.

5. CONCLUSION

52. In sum, available data show that (a) Madison County's 21 census tracts can be divided broadly into two geographic areas with substantially different racial populations—one area which is 17.6% Black and one area which is 66.0% Black, and (b) the frequency of roadblocks per 1,000 residents is higher in the areas of Madison County where a relatively higher percentage of the population is Black.

53. A multivariate regression analysis that controls for differences across each of the 21 census tracts that are predictive of traffic behavior—the rate of DUI arrests, traffic arrests and citations, average income, age, vehicle ownership, unemployment rate—finds a statistically significant and positive relationship between the number of roadblocks per year in census tracts in Madison County and the percentage of the population that is Black in those census tracts. In other words, even after accounting for the fact that census tracts with a higher percentage of Black residents have higher levels of DUI arrests, higher levels of traffic arrests and citations, and different socioeconomic characteristics, there remains an unexplained gap in the rate of roadblocks in those communities.

A handwritten signature in black ink, appearing to read 'Bryan Ricchetti', written over a horizontal line.

Bryan Ricchetti, Ph.D.

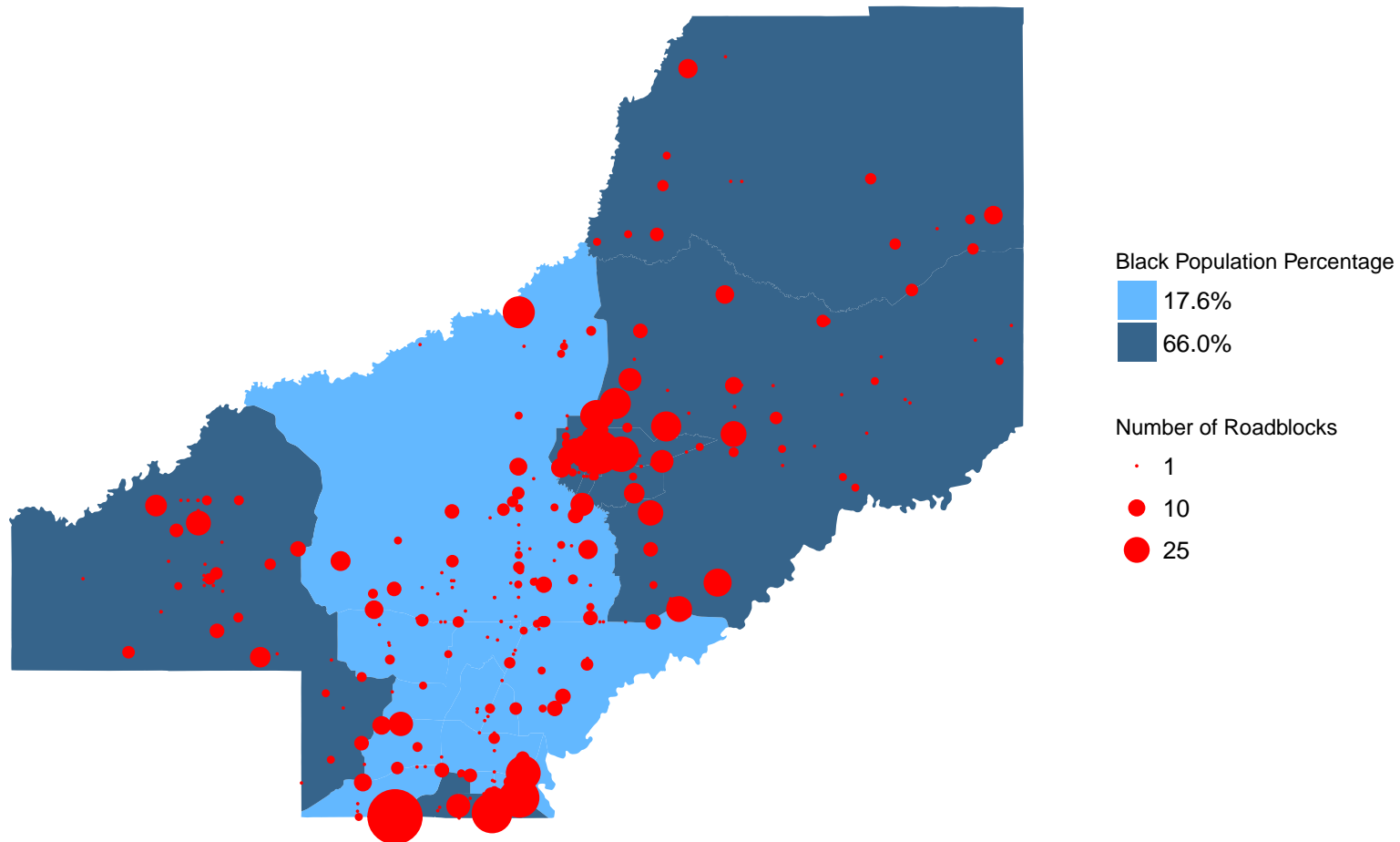
**Average Percentage of the
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28089031000	84.0%
28089030500	89.5%
Average of Census Tracts with High Black Population Percentage	
	66.0%

Source: American Community Survey Five Year Estimates, U.S. Census Bureau

Note: Average Black population percentage figures are calculated from the 2012–2016 American Community Survey Five Year Estimates. The Census Bureau has yet to release 2013–2017 American Community Survey Five Year Estimates. Weighted average Black population percentages across 2012–2017 are reported, and 2016 data are used for 2017.

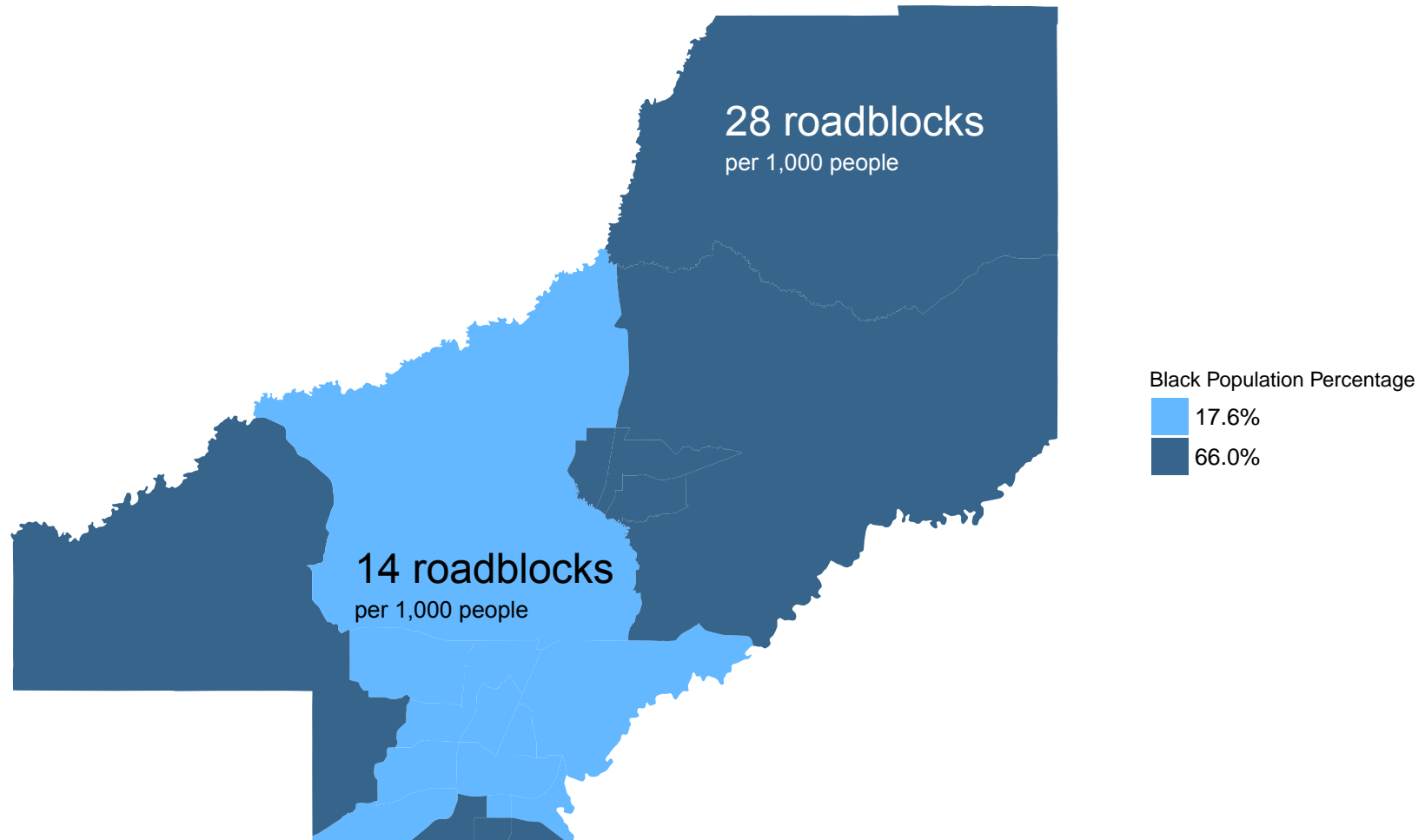
Location of Roadblocks by Census Tract within Madison County 2012–2017



Source: American Community Survey Five Year Estimates – Geodatabase Format, U.S. Census Bureau; Roadblock Locations (Handwritten).xlsx; Unlisted Roadblocks.xlsx; Master CAD Report – To Be Produced.csv

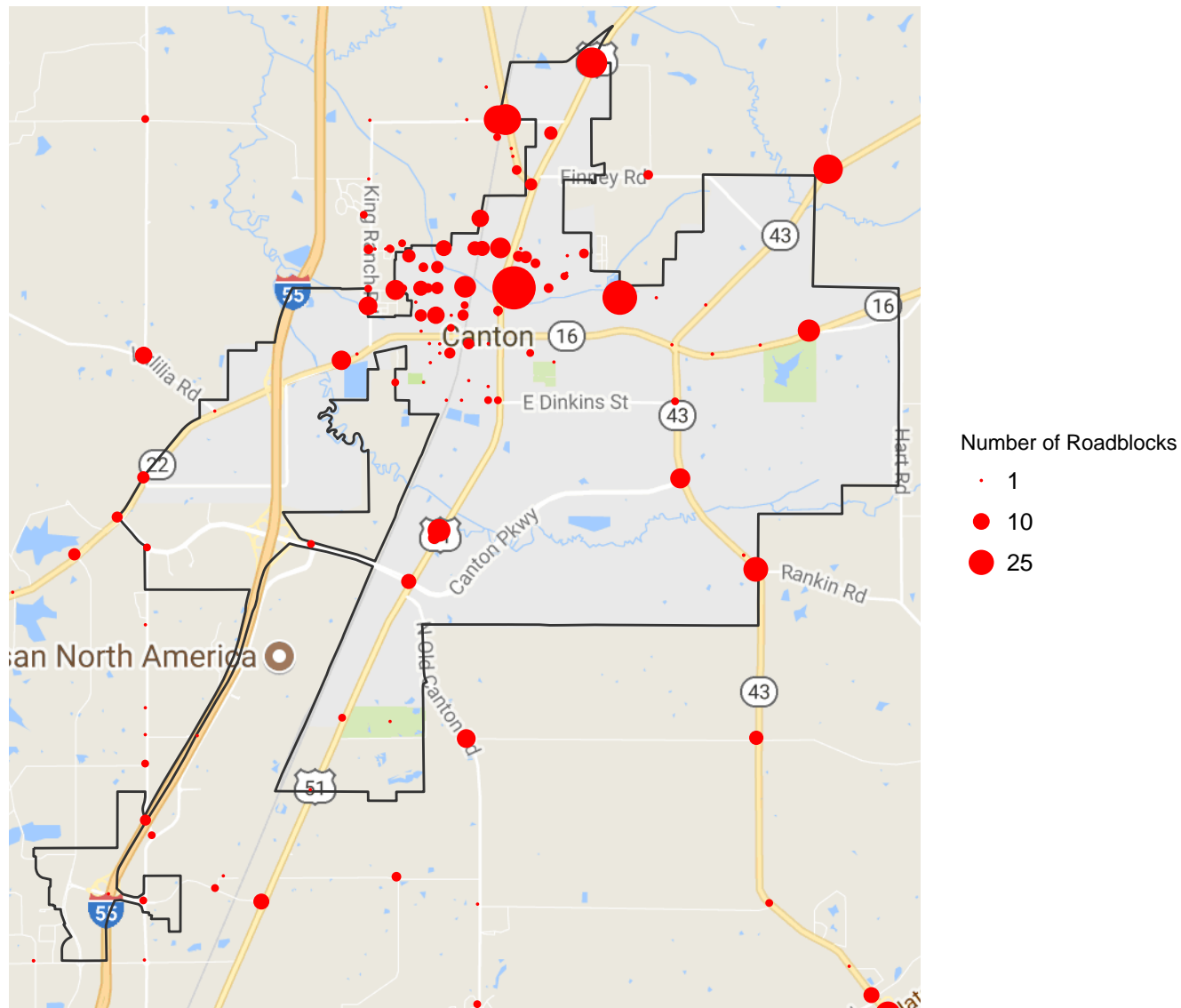
Note: Census tracts that are 46% Black or more are shaded dark blue, and census tracts that are 28% Black or less are shaded light blue. There are no census tracts with a Black population percentage between 29% and 45%. Black population percentage and total population figures are from the ACS Five Year Estimates. This map uses the weighted average across 2012–2017 for both of these values, and 2016 data is used for 2017. This map includes roadblocks in Madison County for which accurate coordinates are available. Dots are scaled by the number of roadblocks at a given longitude and latitude.

Frequency of Roadblocks by Racial Breakdown



Source: American Community Survey Five Year Estimates – Geodatabase Format, U.S. Census Bureau; Roadblock Locations (Handwritten).xlsx; Unlisted Roadblocks.xlsx; Master CAD Report – To Be Produced.csv

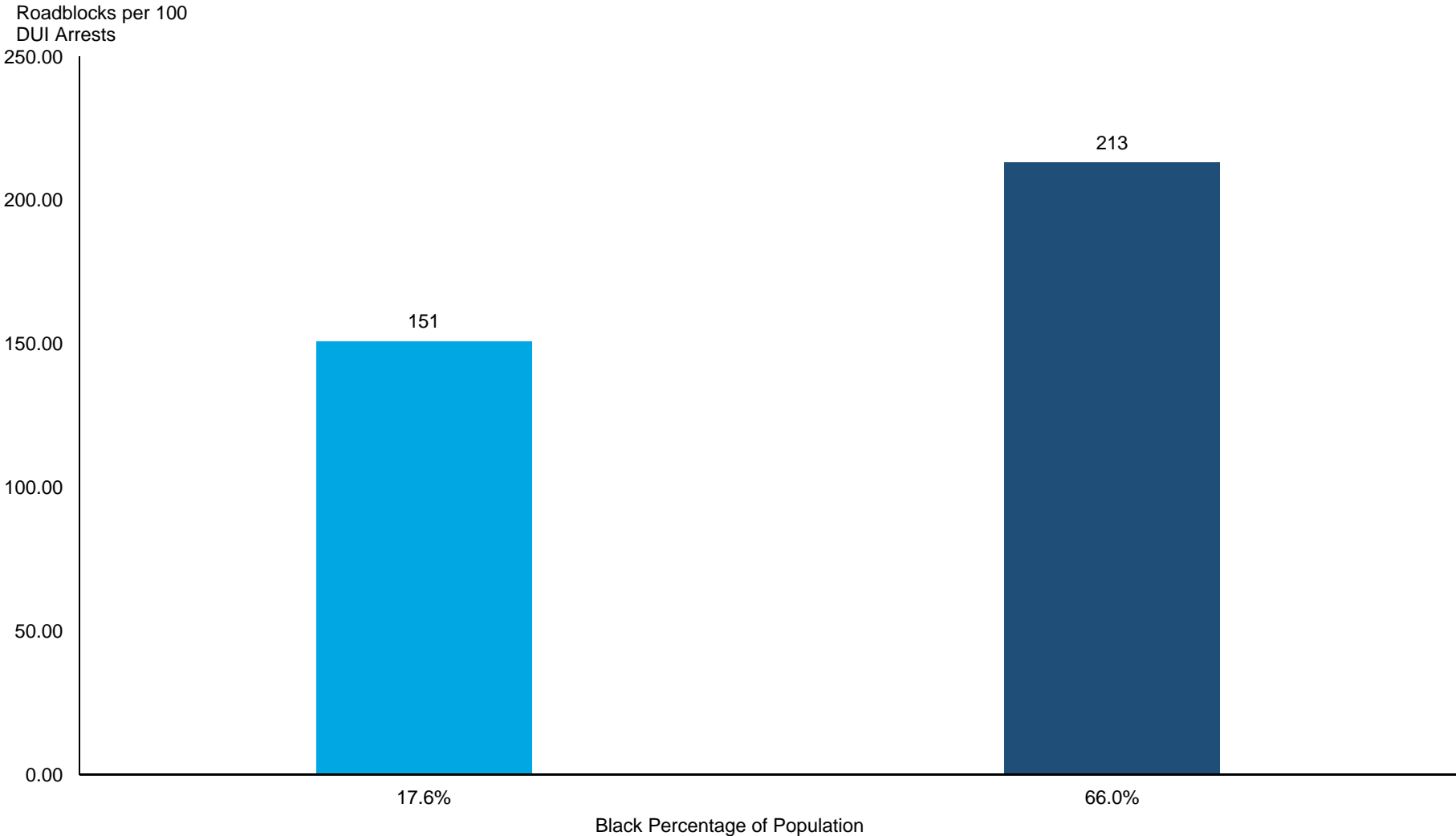
Note: Census tracts that are 46% Black or more are shaded dark blue, and census tracts that are 28% Black or less are shaded light blue. There are no census tracts with a Black population percentage between 29% and 45%. Black population percentage and total population figures are from the ACS Five Year Estimates. This map uses the weighted average across 2012–2017 for both of these values, and 2016 data is used for 2017. Roadblock counts include roadblocks from 2012 through 2017.

Roadblocks Located in Canton

Source: Tiger/Line Shapefiles: Places – Mississippi, U.S. Census Bureau; Roadblock Locations (Handwritten).xlsx; Unlisted Roadblocks.xlsx; Master CAD Report – To Be Produced.csv; Google Maps

Note: This map includes roadblocks for which accurate coordinates are available. Dots are scaled by the number of roadblocks at a given longitude and latitude.

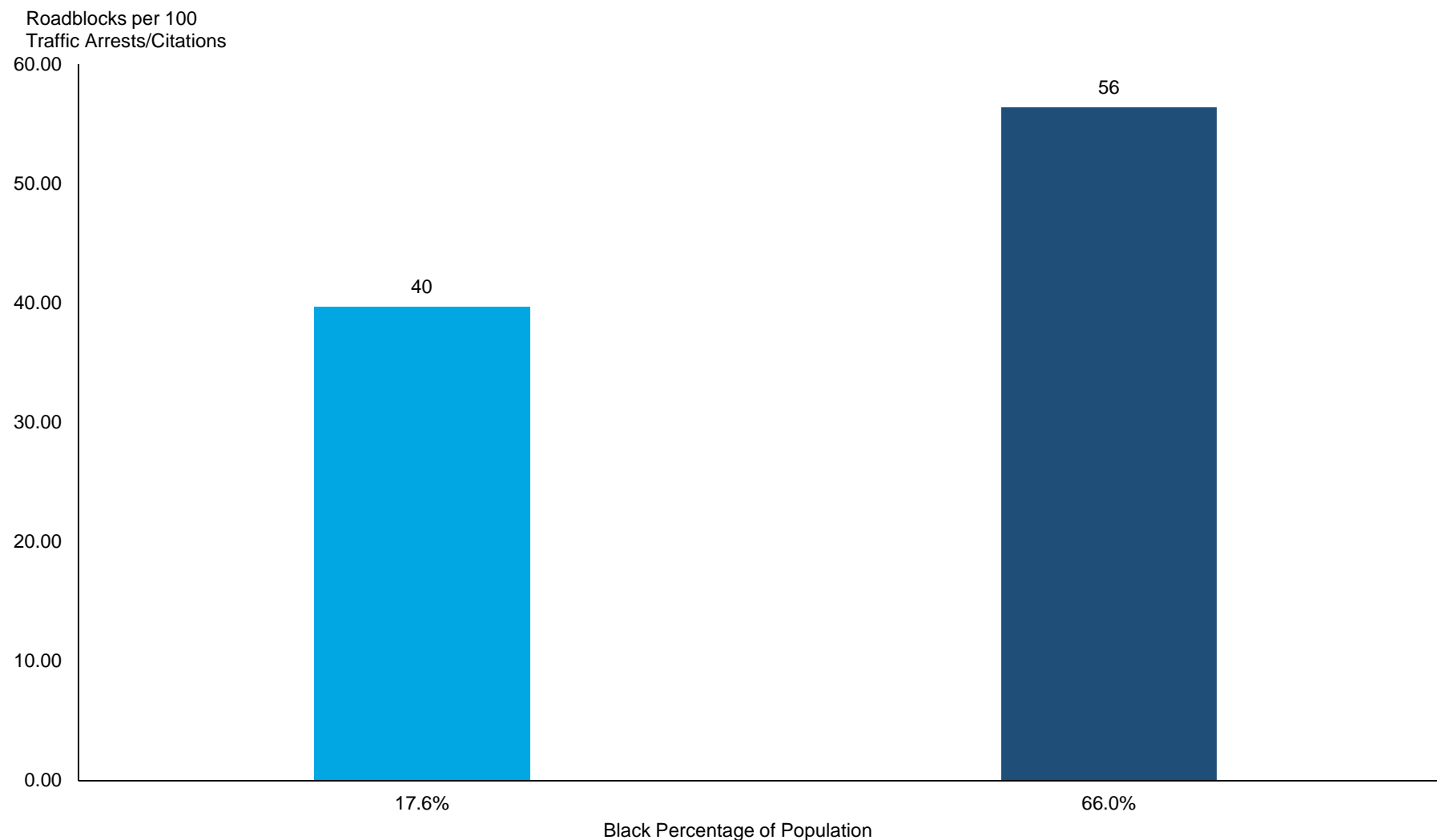
Roadblocks per 100 DUI and Traffic Violations by Racial Breakdown



Source: Master CAD Report - To Be Produced.csv; Roadblock Locations (Handwritten).xlsx; Unlisted Roadblocks.xlsx; American Community Survey Five Year Estimates, U.S. Census Bureau

Note: The Census Bureau has yet to release the 2013–2017 American Community Survey Five Year Estimates. Data from the 2012–2016 American Community Survey Five Year Estimates are used for observations in both 2016 and 2017.

Roadblocks per 100 DUI and Traffic Violations by Racial Breakdown



Source: Master CAD Report - To Be Produced.csv; Roadblock Locations (Handwritten).xlsx; Unlisted Roadblocks.xlsx; American Community Survey Five Year Estimates, U.S. Census Bureau

Note: The Census Bureau has yet to release the 2013–2017 American Community Survey Five Year Estimates. Data from the 2012–2016 American Community Survey Five Year Estimates are used for observations in both 2016 and 2017.

Regression Results: Effect of Race on Frequency of Roadblocks, Controlling for Other Factors^[1] 2012–2017

Variable ^[2]	(1)	(2)	(3)
	With DUI Arrests ^[3]	With Traffic Citations/Arrests ^[4]	With DUI Arrests and Traffic Citations/Arrests ^[5]
Black Percentage of Population	0.06492	0.05829	0.06218
standard error	0.01756	0.02486	0.01721
p-value	0.00033	0.02073	0.00044
Number of DUI Arrests Per 1,000 People	1.22070		1.38900
standard error	0.10390		0.12150
p-value	0.00000		0.00000
Number of Traffic Citations/Arrests Per 1,000 People		0.15220	-0.10300
standard error		0.04928	0.04075
p-value		0.00251	0.01281
Median Household Income (in Thousands)	0.03166	0.01685	0.02669
standard error	0.01588	0.02260	0.01566
p-value	0.04851	0.45750	0.09094
Unemployment Rate	-0.11910	-0.36860	-0.07771
standard error	0.07720	0.10540	0.07727
p-value	0.12550	0.00066	0.31660
Percentage of Households with At Least One Vehicle	-0.05640	-0.33580	-0.09574
standard error	0.07273	0.10080	0.07282
p-value	0.43960	0.00115	0.19120
Percentage of Population between Ages 15-24	-0.03368	-0.08256	-0.04544
standard error	0.04824	0.06838	0.04742
p-value	0.48640	0.22970	0.33980
Constant	2.58350	33.99400	7.05080
standard error	7.80860	10.80700	7.83940
p-value	0.74130	0.00209	0.37030
Observations	126	126	126
Adjusted R-Squared	0.646	0.293	0.662

Source: Master CAD Report - To Be Produced.csv; American Community Survey Five Year Estimates, U.S. Census Bureau

Note:

[1] All Specifications include only CAD Roadblocks.

[2] The Census Bureau has yet to release the 2013–2017 American Community Survey Five Year Estimates. Data from the 2012–2016 American Community Survey Five Year Estimates are used for observations in both 2016 and 2017.

[3] Specification (1) uses number of DUI arrests per 1,000 people per year by census tract as a control variable.

[4] Specification (2) uses number of traffic citations and arrests per 1,000 people per year by census tract as a control variable.

[5] Specification (3) uses both number of DUI arrests and number of traffic citations and arrests as control variables.

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ACADEMIC BACKGROUND

9/02 – 7/07 **Cornell University** Ithaca, New York
Ph.D., Economics, Applied Econometrics, Labor Economics

9/95 – 5/99 **Hamilton College** Clinton, New York
B.A., Economics with Honors, Magna Cum Laude, Phi Beta Kappa

PROFESSIONAL EXPERIENCE

9/07 – Present **Cornerstone Research, Inc.** Chicago, Illinois

Vice President

- Manage and conduct economic analysis for complex business litigation and regulatory matters, with specialization in antitrust, labor, class action, market manipulation and product misrepresentation matters.
- Expertise applying a wide range of empirical and theoretical methods to complicated market settings, including the application of statistical methods to analysis of large, proprietary data sets.
- Industry focus includes: retail, food and agriculture, the economics of distribution, and sports economics.

Selected Consulting Experience

- *Wage Discrimination Matter* Analyzed claims of gender discrimination. Oversaw the statistical analysis of wage and promotion patterns in internal personnel records for one of the largest employers in the world.
- *Monopsony Wage Fixing Cartel in Sports Industry* Analyzed claims that wages were capped by a sports regulatory organization. Oversaw statistical analysis of key issues.
- *Monopsony Wage Fixing Cartel in Service Industry* Analyzed claims of monopsony wage suppression in service industry. Managed and implemented statistical analysis of complex payroll records. Conducted liability and damages analysis.

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- *Wage Discrimination Consulting Matters* Analyzed wage and promotion patterns in internal personnel records for large private company. Implemented econometric tests.
- *Wrongful Termination Gender Discrimination Matter* Analyzed wage and job history data to assess damage claims for employees who were allegedly wrongfully terminated by employer.
- *Alleged Cartels in Dairy Industry* (*Alice H. Allen et al. v. Dairy Farmers of America, Inc., et al. and Sweetwater Valley Farm, Inc., et al., v. Dean Foods Company, et al.*) Analyzed liability, damages, and class certification issues in multiple cases alleging vertical and horizontal conspiracies, price-fixing and quantity restrictions in the dairy industry. Analyzed pricing data at all levels of the industry, including issues of pass-through. Oversaw implementation of econometric analysis.
- *Alleged Monopoly and Foreclosure in Home Recreation Industry* Assessed claims of attempted monopoly and foreclosure by large distributor of home recreation products. Developed statistical model of damages to measure alleged impact of challenged conduct.
- *Merger in Food and Agriculture Industry* Analyzed potential economic impacts of a proposed merger between two large distributors. Assessed industry structure, competitive landscape, and possible price effects.
- *Regulatory matters involving state-level alcohol laws* Analyzed the economic impact of changes to state-level laws related to the distribution of beer, wine, and liquor in one state, and retail sale of liquor in another state. Assessed the potential effect of law change on alcohol consumption, tax revenue, and relevant social and economic outcomes.
- *LIBOR Manipulation Matters* Conceptualized and managed econometric analysis to understand the effect of the alleged conduct on rate trends. Prepared findings for regulatory investigation.

9/03 – 9/07 **US Census Bureau, LEHD**

Ithaca, New York

Labor Economist

- Conducted econometric analysis related to research program on data confidentiality. Performed complex statistical modeling of key labor market outcomes. Authored internal papers and presentations.

7/99 – 7/2002 **MDRC**

New York, New York

Research Assistant

- Conducted economic and statistical analyses of the effect of welfare-to-work programs on labor market outcomes.

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TESTIMONY

Wal-Mart Puerto Rico, Inc. v. Juan C. Zaragoza-Gomez U.S. District Court, District of Puerto Rico. Retained by counsel for Plaintiff. Analyzed statistics issue. Filed affidavit on 1/19/16, deposed, and testified at trial.

Dunmars v. Board of Trustees of Community College District No. 510 and Jorie Menclewicz U.S. District Court, Northern District of Illinois, Eastern Division. Retained by counsel for Plaintiff. Damages analysis in lost wages matter. Report filed on 3/18/16.

Scott Swanson v. Epic Systems Corporation U.S. District Court, Western District of Wisconsin. Retained by counsel for Defendant. Rebuttal of Plaintiff expert regression analysis in age discrimination matter. Report filed on 9/5/17.

Boston Chapter, NAACP, Inc., et al. v. Nancy B. Beecher et al., and Pedro Castro et al., v. Nancy B. Beecher et al., U.S. District Court, District of Massachusetts. Retained jointly by Plaintiffs and Defendants. Analysis of qualified labor pool for entry-level police and firefighters. Report filed on 10/11/17.

Winn-Dixie Stores, Inc. and Bi-Lo Holdings, LLC v. Southeast Milk, Inc., et. Al, U.S. District Court, Middle District of Florida, Jacksonville Division. Retained by counsel for Defendants. Analyzed liability and damages in alleged horizontal quantity restriction conspiracy. Report filed on 2/20/18.

Data Breach matter. Retained as statistics expert to analyze patterns of alleged data breach. Case resolved before report or testimony.

Antitrust matter. Retained to analyze procompetitive aspects of allegedly anticompetitive horizontal agreement. Case resolved before report or testimony.

ARTICLES AND PRESENTATIONS

Moderator, “The Capper Volstead Act - Lessons from the Trenches,” ABA Teleconference Panel, December 9, 2016.

Panelist, 43rd Annual Fordham Conference on Antitrust Law and Policy, Economic Workshop – “Preparing for Deposition and Dealing with *Daubert* Challenges”

Expert Witness, ABA Antitrust Spring Meetings Mock Trial, Spring 2015 (Case involved antitrust issues raised by a hypothetical college athletic association’s restrictions on amateur player compensation)

Expert Witness, Antitrust Law & Economics Institute for Federal Judges Mock Trial, October 2015 (Case involved antitrust issues raised by a hypothetical college athletic association’s restrictions on amateur player compensation)

Co-author, “Applying Econometrics to Assess Market Definition and Market Power,” *Econometrics: Legal, Practical, and Technical Issues*, American Bar Association Section of Antitrust Law.

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Co-author, “Antitrust Impact in Indirect Purchaser Class Actions: The Need for Rigorous Analysis of Pass-Through,” in the forthcoming Spring 2015 ABA Antitrust Distribution and Franchising Committee Newsletter

“Interpreting Comcast: Judge Koh’s Decision in *Brazil v. Dole Foods*,” in the Winter 2015 ABA Agriculture and Food Committee Newsletter.

Contributor, “How Effective Are Different Welfare-to-Work Approaches? Five-Year Adult and Child Impacts for Eleven Programs.” December 2001, New York: MDRC.

Co-Author, ABA Handbook, Chapter on Pricing Regulations in the Dairy Industry, *Forthcoming*.

“Testing Disclosure Risk in the proposed SIPP-IRS-SSA Public Use Files,” *Cornell University Dissertation*, August 2007 (and submitted to U.S. Census Bureau Disclosure Review Board, November 2016).

“Turnover as a Gateway to Symmetric Information: Testing Patterns of Entry into Personnel Records,” *Cornell University Dissertation*, August 2007.

“Piece-Rates, Salary, Performance and Job Level,” *Cornell University Dissertation*, August 2007.

ACADEMIC HONORS AND AWARDS

Walter Galenson Fellowship in Labor Economics, Cornell University	Spring 2005
Scholarship Prize in Economics, Hamilton College	Spring 1998

Documents Considered by Bryan Ricchetti, Ph.D.

Legal Pleadings

- Answer and Affirmative Defenses of Defendants, Madison County, Mississippi and Sheriff Randall C. Tucker, In His Official Capacity, *Latoya Brown; Lawrence Blackmon; Herbert Anthony Green; Khadafy Manning; Quinnetta Manning; Marvin McField; Nicholas Singleton; Steven Smith; Bessie Thomas; and Betty Jean Williams Tucker, individually and on behalf of a class of all others similarly situated, v. Madison County, Mississippi; Sheriff Randall S. Tucker, in his official capacity; and Madison County Sheriff's Deputies John Does #1 through #6, in their individual capacities*, CIVIL ACTION NO. 3:17-cv-347 WHB LRA. June 29, 2017
- Class Action Complaint for Declaratory and Injunctive Relief and Individual Damages, *Latoya Brown; Lawrence Blackmon; Herbert Anthony Green; Khadafy Manning; Quinnetta Manning; Marvin McField; Nicholas Singleton; Steven Smith; Bessie Thomas; and Betty Jean Williams Tucker, individually and on behalf of a class of all others similarly situated, v. Madison County, Mississippi; Sheriff Randall S. Tucker, in his official capacity; and Madison County Sheriff's Deputies John Does #1 through #6, in their individual capacities*, CIVIL ACTION NO. 3:17-cv-347 WHB LRA. May 8, 2017
- Defendants' Memorandum of Authorities in Opposition to Plaintiffs' Motion to Compel, *Latoya Brown; Lawrence Blackmon; Herbert Anthony Green; Khadafy Manning; Quinnetta Manning; Marvin McField; Nicholas Singleton; Steven Smith; Bessie Thomas; and Betty Jean Williams Tucker, individually and on behalf of a class of all others similarly situated, v. Madison County, Mississippi; Sheriff Randall S. Tucker, in his official capacity; and Madison County Sheriff's Deputies John Does #1 through #6, in their individual capacities*, CIVIL ACTION NO. 3:17-cv-347 WHB LRA. November 3, 2017
- Order Granting Motion to Compel, *Latoya Brown; Lawrence Blackmon; Herbert Anthony Green; Khadafy Manning; Quinnetta Manning; Marvin McField; Nicholas Singleton; Steven Smith; Bessie Thomas; and Betty Jean Williams Tucker, individually and on behalf of a class of all others similarly situated, v. Madison County, Mississippi; Sheriff Randall S. Tucker, in his official capacity; and Madison County Sheriff's Deputies John Does #1 through #6, in their individual capacities*, CIVIL ACTION NO. 3:17-cv-347 WHB LRA. December 27, 2017
- Response by Defendants, Madison County, Madison County, Mississippi and Sheriff Randall Tucker, in his official capacity to Plaintiffs' First Set of Interrogatories, *Latoya Brown; Lawrence Blackmon; Herbert Anthony Green; Khadafy Manning; Quinnetta Manning; Marvin McField; Nicholas Singleton; Steven Smith; Bessie Thomas; and Betty Jean Williams Tucker, individually and on behalf of a class of all others similarly situated, v. Madison County, Mississippi; Sheriff Randall S. Tucker, in his official capacity; and Madison County Sheriff's Deputies John Does #1 through #6, in their individual capacities*, CIVIL ACTION NO. 3:17-cv-347 WHB LRA. October 20, 2017

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- Perrine, M.W., Raymond C. Peck, and James C. Fell, "Epidemiologic Perspectives on Drunk Driving," Surgeon General's Workshop on Drunk Driving, Background Papers, *U.S. Department of Health and Human Services*, pp. 35–76. 1988
- Ridgeway, Greg, and John MacDonald, "Methods for Assessing Racially Biased Policing," *Race, Ethnicity, and Policing: New and Essential Readings, Infrastructure, Safety, and Environment*, NYU Press, pp. 180–204. 2010
- Rubinfeld, Daniel L., "Reference Guide on Multiple Regression," *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, The National Academies Press, Washington, D.C. 2011

Data

- American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi, Age and Sex 2012–2016
- American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi, Employment Status 2012–2016
- American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi, Housing Characteristics 2012–2016
- American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi, Median Household Income 2012–2016
- American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi, Race 2012–2016
- American Community Survey Five Year Estimates for All Places in Madison County, Mississippi, Demographic and Housing Estimates 2016
- American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi - Geodatabase Format, Shapefiles, available at *U.S. Census Bureau*, <https://www.census.gov/geo/maps-data/data/tiger-data.html>. 2015
- Tiger/Line Shapefiles: Places - Mississippi, available at *U.S. Census Bureau*, <https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2017&layergroup=Places>. 2017
- "Master CAD Report – To Be Produced.csv." 2012–2017
- "Roadblock Locations (Handwritten).xlsx." 2012–2017
- "Unlisted Roadblocks.xlsx." 2012–2017
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- "2010 Census – Census Tract Reference Map: Madison County, MS," available at *U.S. Census Bureau*, https://www2.census.gov/geo/maps/dc10map/tract/st28_ms/c28089_madison/DC10CT_C28089_001.pdf. 2010

Other

Sobriety Checkpoint Guidelines, Policy and Procedure, MC-RFP 2-1–MC-RFP 2-4

Regression Sensitivity of Number of Roadblocks Per 1,000 People by Census Tract

Variable ^[1]	(1) Incl. Handwritten Roadblocks ^[2]	(2) Incl. Additional Roadblocks ^[3]	(3) Including All Roadblocks ^[4]	(4) 2014–2017 ^[5]	(5) 2015–2016 ^[6]
Black Percentage of Population	0.06133	0.06200	0.06115	0.08651	0.11160
standard error	0.01859	0.01750	0.01925	0.02308	0.03285
p-value	0.00128	0.00057	0.00190	0.00035	0.00176
Number of DUI Arrests Per 1,000 People	1.61590	1.54120	1.76810	1.41100	1.50490
standard error	0.13130	0.12360	0.13600	0.15040	0.19820
p-value	0.00000	0.00000	0.00000	0.00000	0.00000
Number of Traffic Citations/Arrests Per 1,000 People	-0.12270	-0.11190	-0.13170	-0.11260	-0.15470
standard error	0.04402	0.04146	0.04560	0.05176	0.07730
p-value	0.00618	0.00795	0.00461	0.03268	0.05332
Median Household Income (in Thousands)	0.02594	0.02261	0.02187	0.04232	0.05838
standard error	0.01692	0.01593	0.01752	0.02104	0.03049
p-value	0.12780	0.15840	0.21450	0.04782	0.06394
Unemployment Rate	-0.09300	-0.09165	-0.10690	-0.08406	0.01836
standard error	0.08346	0.07860	0.08645	0.11340	0.16420
p-value	0.26740	0.24600	0.21850	0.46080	0.91160
Percentage of Households with At Least One Vehicle	-0.09488	-0.08740	-0.08654	-0.09099	-0.21380
standard error	0.07866	0.07408	0.08148	0.10020	0.15200
p-value	0.23020	0.24040	0.29030	0.36680	0.16860
Percentage of Population between Ages 15-24	-0.04124	-0.05159	-0.04739	-0.01959	-0.09472
standard error	0.05122	0.04823	0.05305	0.05941	0.08334
p-value	0.42230	0.28690	0.37350	0.74240	0.26370
Constant	7.11280	6.74560	6.80770	4.18290	15.08500
standard error	8.46820	7.97440	8.77090	10.62100	16.21300
p-value	0.40260	0.39930	0.43920	0.69480	0.35870
Observations	126	126	126	84	42
Adjusted R-Squared	0.683	0.695	0.704	0.666	0.741

Source: Master CAD Report - To Be Produced.csv; Roadblock Locations (Handwritten).xlsx; Unlisted Roadblocks.xlsx; American Community Survey Five Year Estimates, U.S. Census Bureau

Note:

[1] The Census Bureau has yet to release the 2013–2017 American Community Survey Five Year Estimates. Data from the 2012–2016 American Community Survey Five Year Estimates are used for observations in both 2016 and 2017.

[2] Specification (1) includes only CAD Roadblocks and Handwritten Roadblocks.

[3] Specification (2) includes only CAD Roadblocks and Additional Roadblocks.

[4] Specification (3) includes all CAD Roadblocks, Handwritten Roadblocks, and Additional Roadblocks.

[5] Specification (4) includes only CAD Roadblocks that occurred between 2014–2017.

[6] Specification (5) includes only CAD Roadblocks that occurred between 2015–2016.

EXHIBIT 2

**UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
JACKSON DIVISION**

LATOYA BROWN; LAWRENCE
BLACKMON; HERBERT ANTHONY
GREEN; KHADAFY MANNING;
QUINNETTA MANNING; MARVIN
MCFIELD; NICHOLAS SINGLETON;
STEVEN SMITH; BESSIE THOMAS; and
BETTY JEAN WILLIAMS TUCKER,
individually and on behalf of a class of all
others similarly situated,

Plaintiffs,

v.

MADISON COUNTY, MISSISSIPPI;
SHERIFF RANDALL S. TUCKER, in his
official capacity; and MADISON COUNTY
SHERIFF'S DEPUTIES JOHN DOES #1
through #6, in their individual capacities,

Defendants.

Civil Action No.

3:17-cv-00347-WHB-LRA

REBUTTAL EXPERT REPORT OF BRYAN RICCHETTI, Ph.D.

July 2, 2018

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1. SUMMARY OF FINDINGS

1. Since filing my initial report on March 13, 2018, I have reviewed the reports of Dr. Steward and Mr. Funderburk. In this report, I address the claims made in those two reports. In particular, I explain how Dr. Steward's claims that my methodology is unreliable stem from a misunderstanding of widely accepted econometric methods. As I detail below, this is evidenced by the fact that the methods I use are widely accepted in both academia and by the Courts. Further, Dr. Steward and Mr. Funderburk overstate the extent of certain data issues, and do not use widely accepted statistical methods to test whether my findings are sensitive to the various data issues they identify. As I show below, my results are robust to each of the claims made.

2. I begin my analysis in Section 2, where I address a variety of claims that Dr. Steward makes about the methodology of my model and its use in the academic literature. As I explain in that section, Dr. Steward misunderstands how my model works, and incorrectly asserts that my methodological approach is not used in the academic literature. The methodology I use has been used in published academic work and has been accepted by Courts. In fact, Dr. Steward has himself used the general methodology in prior work as an expert witness. Below is a summary of my key findings on these points:

- Dr. Steward claims that my model does not account for the driving population.¹ This is simply untrue. Consistent with the academic literature on policing that I cite to in my original report (and that Dr. Steward cites to in his report), my analysis controls directly for the population of motorists who most directly contribute to roadblock placement, using data from MCSD on DUIs and traffic violations. In fact, Dr. Steward asserts that "the key factor in MCSD traffic roadblock location placement" is DUI frequency of motorists, which is the central control variable in my model.² Yet despite the fact that DUI frequency

¹ Rebuttal Report of Dwight D. Steward, Ph.D. RE: Bryan Ricchetti, Ph.D., May 8, 2018 ("Steward Report"), ¶ 38.

² Steward Report, ¶¶ 54–61.

is included in my model, Dr. Steward incorrectly asserts that my model does not account for the driving population.³

- Dr. Steward also incorrectly asserts that I use the share of residents in each census tract that are Black as a measure of the share of drivers in each census tract who are Black.⁴ This reflects a misunderstanding of my model. As I explain below, the control variable for race in my model is included as a way to test whether roadblocks are more frequent in areas of Madison County with a higher fraction of Black residents, controlling for the level of risky driving behavior of the *motorists* in those areas. As I understand it, a central claim in this case is that residents in predominantly Black areas of Madison County claim that roadblocks and other policing activity disrupt their daily lives. The purpose of my model is to assess whether the frequency of roadblocks are more common in areas that have a higher share of Black residents after controlling for the relevant driving behavior of motorists. As I discuss below, this general modeling approach has been published in peer-reviewed journals in the academic literature to assess whether policing activity differs across neighborhoods with a higher share of Black residents, after controlling for relevant crime behavior. It has also been relied on by Courts. More generally, the type of regression model I use in my analysis is a fundamental tool in economics, and a widely accepted tool for examining claims of racial disparities in a wide variety of settings (e.g., crime, hiring/pay, poverty and employment outcomes, and housing market redlining).
- Dr. Steward also makes a basic arithmetic error when interpreting the size of the coefficient on race in my model. This error leads him to substantially understate the relationship between roadblock frequency and the share of the population that is Black across census tracts.
- Dr. Steward also claims that analyzing outcomes at the census tract level “undercuts reliability” and is not standard methodology.⁵ This is, again, untrue. Regression analyses that compare outcomes across geographic areas (like census tracts, counties, cities, states, etc.) have been widely

³ Steward Report, ¶¶ 47–48.

⁴ Steward Report, ¶ 36.

⁵ Steward Report, ¶ 46.

published in top academic journals, accepted by the Courts, and used to assess a wide variety of questions related to race, discrimination, public policy, and crime. Dr. Steward himself has used such methods as an expert, applying them to even larger geographic areas than census tracts. My use of census tract-level data is appropriate and reliable.

- Finally, Dr. Steward misrepresents and misunderstands the purpose of the descriptive statistics presented in my first report, asserting that I did not perform a test for statistical significance and that my results somehow depend on there being a specific racial threshold for alleged bias.⁶ This is untrue. The summary of descriptive statistics presented in my first report is designed to provide an overview of relevant patterns in how the racial population varies across areas of Madison County. As detailed below, starting an analysis with a descriptive summary of key variables is standard practice in peer-reviewed articles that use regression models. As I explained in my initial report, in order to do a proper statistical test of differences in roadblocks across census tracts with different racial breakdowns, a regression model is required. I present a series of regression models that offer such tests in my original report, and that impose *no assumption* on which census tracts have a high or low share of Black residents. The claim that I have not done a proper statistical test is incorrect.

3. In Section 3 of my report, I address the claims that Dr. Steward and Mr. Funderburk raise about the roadblock data. I make several points in that section:

- First, the fact that the data on roadblock location provided by MCSD includes the location of the intersection, rather than an exact address, is not by itself a problem for my analysis. The purpose of my analysis is to look at the frequency of roadblocks across census tracts. As Mr. Funderburk's own analysis shows, the vast majority of intersections in the MCSD data can be cleanly delineated into individual census tracts.⁷ As noted above, it is common in academic research to analyze patterns across different geographic units, like census tracts.

⁶ Steward Report, ¶ 64–65.

⁷ Expert Report of William R. Funderburk, May 8, 2018 ("Funderburk Report"), ¶ 57.

- Second, while Dr. Steward and Mr. Funderburk are correct that some roadblocks are located on the boundary of various census tracts, this fact does not render my analysis unreliable. Such measurement imperfections are a standard part of statistical and economics analysis, and are common in numerous published academic papers that analyze differences across geographic units in various outcomes using regression models. As I explain below, this common feature of data and regression analysis reflects one of the more basic econometric issues discussed in econometrics textbooks (known as “measurement error”), and is understood to typically make an analysis like mine *conservative* because it makes it *less likely* (not more) to find a statistically significant coefficient on the race variable. Further, it is well recognized that there are ways to test whether such measurement error would, in fact, bias my analysis and generate unreliable conclusions. Dr. Steward and Mr. Funderburk do not attempt to answer this question in any way.
- As I show below, when I use standard sensitivity analyses accepted in the academic literature, I show that my findings are unchanged. For example, as I show in Section 3, when my analysis focuses only on roadblocks not near the boundary, my main findings are unchanged. In fact, even if I assume that all of the roadblocks on a boundary occurred in the bordering census tract with the highest white population, my results hold. These tests demonstrate that the higher frequency of roadblocks in census tracts with a higher share of Black residents, found in my original analysis, is not a result of the roadblocks on the boundary between census tracts. Critically, neither Dr. Steward nor Mr. Funderburk offer any analysis to show that the location of certain roadblocks near census tract boundaries affect or change my results in any way.

2. DR. STEWARD MISUNDERSTANDS KEY FEATURES OF MY ANALYSIS, WHICH IS BASED ON METHODS WIDELY USED IN THE ACADEMIC LITERATURE

4. Dr. Steward fundamentally misunderstands the logic of my statistical analysis. Dr. Steward’s claims about my model can be grouped into several broad categories, each of which I address in this section.

2.1. My model controls for relevant driving behavior of motorists in census tracts

5. Multiple times in his report, Dr. Steward emphasizes the importance of controlling for the “driving population” on the road when building a statistical model of roadblock frequency.⁸ Dr. Steward and I are in agreement on this point – any analysis of roadblock placement must account for the driving behavior of the drivers in the area where roadblocks occur. Where Dr. Steward and I disagree is his claim that my statistical model somehow does not account for the driving population of motorists in Madison County relevant for determining roadblock placement.⁹

6. As I detail in my first report, the most important control variables in my model are the frequency of DUIs and traffic violations of drivers in each census tract. These variables are direct measures of the behavior of motorists in each census tract in Madison County. Indeed, in my initial report I explicitly discuss the importance of controlling for driving behavior and cite to the relevant literature.

“There is also a body of research literature focused on the specific question of differential policing and policing outcomes across race. That literature also emphasizes the importance of controlling for relevant, non-race factors when assessing claims of racial profiling or bias by police. For example, one study funded by the U.S. Department of Justice to help law enforcement officials and researchers better understand how to analyze data on race and vehicle stops notes ‘the strongest research methodologies will address the alternative hypothesis that racial/ethnic groups are not equivalent in the nature and extent of their traffic law-violating behavior.’

Another paper, which summarizes common statistical methods used for analyzing policing data, discusses the importance of controlling for “driving behavior that may be important sources for police decision-making, such as the likelihood of speeding, weaving through traffic, and driving slower than usual,” when analyzing traffic violations across race.”¹⁰

⁸ Steward Report, ¶¶ 36–39; 45–47.

⁹ Steward Report, ¶¶ 47–53.

¹⁰ Expert Report of Bryan Ricchetti, Ph.D., March 13, 2018 (“Ricchetti Report”), ¶¶ 18–20.

7. Despite the fact that I discussed these issues in my report and include in my model multiple measures of driving behavior (and explicitly discuss how those measures are the strongest variables in my model), Dr. Steward asserts that my model relies only on information about the “residential population” in each census tract.¹¹ As demonstrated above, this claim by Dr. Steward is simply untrue. The central control variable in my model is the frequency of DUIs of motorists in each census tract, which Dr. Steward acknowledges in his own report is “the key factor” in roadblock placement.¹²

8. In addition to directly controlling for the relevant driving behavior of motorists that give rise to roadblocks, I also include several control variables related to the population of residents in each census tract. As I explain in my report, I include these controls *in addition to* direct controls for motorists for two main reasons. One is to account for MCSD’s claim that the need for their policing resources varies across the county depending on the economic resources of the local police department.¹³ These variables are, thus, important to the model. Dr. Steward ignores my explanation of this issue. The second is to add *incremental* information to the model beyond direct measures of motorist behavior. This also consists of two variables – vehicle ownership and age – which, as noted in my first report, are understood to be correlated with driving behavior.¹⁴

9. As I explain more below in Section 2.4, the approach of using variables that control *both* for direct measures of crime occurring in a neighborhood and for the neighborhood characteristics is used in the academic literature. Further, as I show below in Section 2.5, even if I were to take Dr. Steward’s concerns at face value and exclude from my model information predictors about the driving behavior of *residents* in the neighborhood, the results of my model hold. It is notable that

¹¹ Steward Report, ¶ 36.

¹² Steward Report, ¶ 54.

¹³ Answer and Affirmative Defenses of Defendants, Madison County, Mississippi and Sheriff Randall C. Tucker, In His Official Capacity, *Latoya Brown; Lawrence Blackmon; Herbert Anthony Green; Khadafy Manning; Quinnetta Manning; Marvin McField; Nicholas Singleton; Steven Smith; Bessie Thomas; and Betty Jean Williams Tucker, individually and on Behalf of a class of all others similarly situated, v. Madison County, Mississippi; Sheriff Randall S. Tucker, in his official capacity; and Madison County Sheriff’s Deputies John Does #1 through #6, in their individual capacities*, CIVIL ACTION NO. 3:17-cv-347 WHB LRA, dated June 29, 2017, ¶¶ 9, 62.

¹⁴ Fridell, Lorie, “By The Numbers: A Guide for Analyzing Race Data from Vehicle Stops,” Police Executive Research Forum, pp. 79–82.

while Dr. Steward claims that the use of these variables in my report is a major problem, he does not offer any analysis or test to show that they affect my ultimate conclusions. As I note throughout this report, this is a common theme with his criticisms.

10. A related argument that Dr. Steward makes is that because my model does not include measures of bars or restaurants it cannot reliably control for risky driving behavior in each census tract.¹⁵ This argument again appears to misunderstand how the control variables in my model work. As noted above, Dr. Steward acknowledges that DUIs are “the key factor” in roadblock placement.¹⁶ Indeed, as Dr. Steward explains in his own report, the main reason one would want to control for the number of bars and restaurants in an analysis of roadblocks is because drunk driving and/or risky driving is more likely to occur in such areas. However, because my model already includes *direct controls* for drunk driving and traffic violations, adding in indirect measures for drunk driving (like concentration of bars and restaurants) would not be expected change the findings of the model because my model already accounts for these factors through DUIs. I discuss this issue further in Section 2.5 below.

11. In an attempt to support this claim that controlling for bars is important, Dr. Steward runs a version of my model in which he adds controls for boating areas and bars, and asserts that after making this change my model does not find a statistically significant relationship between the share of population that is Black and the frequency of roadblock.¹⁷ However, as I explain below, Dr. Steward’s analysis is flawed for at least two reasons, and when the flaws are corrected Dr. Steward’s own analysis finds the same results as mine. It shows that even when you control for his measures of boating areas and bars the statistically significant relationship between the share of population that is Black and the frequency of roadblocks remains.

¹⁵ Steward Report, ¶¶ 49–50.

¹⁶ See, for example, Steward Report, ¶ 11 (“... DUI activity and not race, is the key factor in MCSD traffic roadblock location placement.”); Steward Report, ¶ 58 (“It my understanding that MCSD receives grant funding from Mississippi Office of Highway Safety (MOHS) in its efforts to reduce the incidents of drunk driving and to assist with cost of establishing DUI traffic roadblocks. It is my understanding that the grant funding is subject to periodic renewal and is contingent on satisfactory achievement of DUI enforcement. Even a cursory look at the traffic roadblock and CAD data shows that the DUI activity in a geographical area during a specific time period is correlated with an increased number of traffic roadblocks in the geographical area in later time periods.”).

¹⁷ Steward Report, ¶ 75.

12. First, it is important to understand that Dr. Steward does not in fact include direct controls for the number of bars or restaurants in his model. Instead, he includes a set of “dummy” variables for certain census tracts that he asserts have relatively high or low density of bars. Such a methodology is less precise than using direct measures of DUIs because it cannot distinguish between the level of intensity of bars and/or unsafe driving across census tracts. It instead assumes there are only three types of areas – high, low, and normal.

13. Second, the only reason Dr. Steward finds a statistically insignificant relationship between the population that is Black and the frequency of roadblocks is because he throws out 80 percent of the data when he runs his analysis. Specifically, instead of running his sensitivity analysis on the full six years of data used in my analysis (126 data points), Dr. Steward runs a separate regression for each year from 2012-2017, each of which has only 21 data points.¹⁸ When I simply re-run his model using the full dataset I used in my analysis – including his controls for bars or boating areas – his model finds a *statistically significant* relationship between the share of the population that is Black and the frequency of roadblocks that is slightly *larger* in magnitude than my model.¹⁹ Similarly, if I simply take the average effect from his six regressions across all six years, it is also larger in magnitude than the effect in my model.

14. For example, in my original model, I find that the coefficient on the share of Black residents is 0.06218, which translates into 112 more roadblocks over the 6 years of data in a census tract that is 80% Black relative to one that is 20%.²⁰ Dr. Steward’s analysis yields a coefficient of 0.06565 averaged across all six years, which translates into 118 more roadblocks in a census tract that is 80% Black relative to one that is 20%.²¹ In other words, Dr. Steward’s analysis does not provide any evidence that accounting for bars or boating areas reduces the

¹⁸ Ricchetti Report, Exhibit 6 has 126 data points. As this is estimated over a six year period, a single year has 21 points.

¹⁹ See workpaper. The coefficient on the share of the population that is Black in Dr. Steward’s model (which controls for bar and boating areas) is 0.06268 when all data are included in the regression. In my original model, the coefficient is 0.06218.

²⁰ Ricchetti Report, ¶ 46.

²¹ See workpaper.

magnitude of the effect of race; Dr. Steward simply conducts an analysis with fewer data points that reduces the statistical power of the sample.

15. Finally, Dr. Steward claims my model suffers from something called simultaneity bias, because DUIs and roadblocks may be determined at the same time.²² As I discuss below, a common way to test for this concern in the academic literature is to use DUIs from the prior year as a control variable (referred to as a “lagged” variable in the literature).²³ The logic of this approach is straightforward – DUIs from the prior year are known at the time roadblocks in the current year are set up, whereas roadblocks from the current year cannot deter DUIs from the prior year. As shown in Exhibit 2, when I do this, my results continue to hold. This is another example of Dr. Steward claiming my model has a shortcoming that it does not have, without running any tests.²⁴

2.2. The role of the race variable in my model

16. Dr. Steward also incorrectly asserts multiple times in his report that my analysis uses the share of *residents* in a census tract who are Black as a substitute/proxy/replacement for the share of drivers on the road who are Black. As I explain here, my model makes no such assumption.

17. The purpose of including race in my model is to assess whether roadblocks are used more frequently in areas of the county that have a higher share of Black residents, after controlling for the driving behavior (e.g., DUIs) that are the main factor for roadblock placement. As I understand it, Plaintiffs claim in this case, among other things, that the MCSD disproportionately establishes roadblocks in particular residential neighborhoods, including in locations such as the entrances and exits of majority–Black housing complexes. Thus, I understand that a relevant

²² Steward Report, ¶ 74 (footnote 32).

²³ Fagan, Jeffrey, et al., “Street Stops and Broken Windows Revisited: The Demography and Logic of Proactive Policing in a Safe and Changing City,” Stephen K. Rice, and Michael D. White, (Eds.), *Race, Ethnicity, and Policing: New and Essential Readings*, New York University Press, New York and London, 2009, pp. 319–320. “First, in the figures, we use reported homicides in the police precinct in the preceding year as the measure of crime. This lagged function allows us to avoid simultaneity concerns from using contemporaneous measures of crime and police actions.”

²⁴ It is worth pointing out that even if one is concerned about potential simultaneity bias, it could actually cut in the opposite direction Dr. Steward claims, and make my analysis conservative. In particular, to the extent it is true that there is a higher roadblock presence in Black census tracts, this will cause a reporting difference in DUIs between different census tracts. That is, DUIs in white census tracts will be less likely to be caught. This would actually cause my analysis to under-estimate the relationship between the share of Black residents in a census tract and the frequency of roadblocks (relative to DUIs in those census tracts) because the model is missing relatively more information on DUIs in census tracts with a higher white population.

question is whether there are more/fewer roadblocks in certain areas of town than would otherwise be expected given the behavior of motorists in those areas.

18. As I explained previously, my model controls for the different driving behavior of *motorists* across census tracts using the DUI variable discussed above, and then asks the question: Given the differences in motorists' behavior, are roadblocks more frequent in areas with different racial populations? I am not in any way using the racial breakdown of residents as a proxy for the racial breakdown of motorists. I am instead using the racial breakdown of residents as a way to assess whether roadblocks are more or less frequent across different parts of Madison County, controlling for driving behavior.

19. Importantly, as I explain in the next section, the general statistical methodology of examining whether policing activities vary with the racial breakdown of a community (after controlling for relevant measures of crime in that community) has been used in published academic papers and accepted by the Courts.

20. In a somewhat related point, Dr. Steward also criticizes the fact that I normalize roadblocks and DUI's by population.²⁵ As noted above, because of the nature of the claims in this case, the number of roadblocks per person in different neighborhoods is an appropriate way to measure of any potential impact on residents. Additionally, as I discuss more below, peer-reviewed papers have used residential population in conjunction with direct measures of crime behavior.

21. Further, as with many of his other claims, Dr. Steward does not perform any tests to show that my use of population to normalize roadblocks has any effect on my analysis. I have. Specifically, to test whether Dr. Steward's criticism has merit, I have re-run my model without normalizing roadblocks, DUIs, and traffic violations by population. My main results are unchanged. See Exhibits 3 and 4 Appendix C. Again, Dr. Steward's criticism of my model without running even a very basic statistical test of whether the criticism affects my results is not the accepted method for analyzing whether a model's findings are sensitive to the

²⁵ Many of Dr. Steward's criticisms focus on the total number of roadblocks, rather than the number of roadblocks per 1,000 people in a census tract, as I focus on in my model. See, for example, Steward Report, ¶¶ 17, 37.

control variables included. If a researcher is concerned that a particular variable (or feature of a model) creates bias in an analysis, they can directly test their concern using sensitivity analysis.²⁶ Dr. Steward does not do this.

2.3. Dr. Steward misinterprets the size of the race coefficient in my model

22. Dr. Steward also presents the rather unorthodox argument that, even though the race variable in my model is statistically significant, the fact that it is smaller in magnitude than the DUI variable means that race is not relevant. In making this argument, Dr. Steward makes several basic interpretation errors, which lead him to both incorrectly calculate the effect that race has on the number of roadblocks, and incorrectly compare the relative impacts of race and DUIs on roadblock placement.

23. For example, Dr. Steward says, “if the African-American population of a census tract increased by 1% per year, then there would be 0.06 more roadblocks in that tract per year...it would take approximately sixteen (16) years for there to be an additional roadblock in that given tract.”²⁷ Dr. Steward’s statement includes several basic errors (both in interpretation and mathematical) that render it inaccurate.

24. First, Dr. Steward does not account for the fact that my model normalizes variables (including roadblocks, the outcome variable of my model) by population.²⁸ This means that my coefficient does not show the effect of race on total roadblocks, it shows the effect of race on roadblocks for every 1,000 residents. Given that the average census tract in Madison County has 5,000

²⁶ Wooldridge, Jeffrey M., *Introductory Econometrics: A Modern Approach*, 5th Edition, South-Western Cengage Learning, Mason, Ohio, 2012, pp. 684-685. (“If your model has some potential misspecification, such as omitted variables, and you use OLS, you should attempt some sort of misspecification analysis of the kinds we discussed in Chapters 3 and 5. Can you determine, based on reasonable assumptions, the direction of any bias in the estimators?... Good papers in the empirical social sciences contain sensitivity analysis. Broadly, this means you estimate your original model and modify it in ways that seem reasonable. Hopefully, the important conclusions do not change.”).

²⁷ Steward Report, ¶56.

²⁸ In deposition testimony, Dr. Steward stated that the roadblock variable in my model is the total number of roadblocks, rather than the number per 1,000 residents. This is incorrect, and was explained in my original report. See Deposition of Dwight Steward, Ph.D., June 22, 2018 (“Steward Deposition”), p. 256:6–12.

residents, Dr. Steward understates the effect of his example by a factor of 5.²⁹ Second, as I describe in my first report, the proper way to interpret my coefficient is to consider two census tracts with different shares of Black residents over the 6 years of data.³⁰ Dr. Steward's thought experiment, which considers how a census tract's race share might change over time, ignores the large variation in the Black share of the population which already exists across census tracts.

25. As is clearly explained in my original report, my model predicts that over a 6 year period there would be 112 roadblocks more in a census track that is 80% Black compared to one that is 20% Black, even after controlling for DUIs.

"The following example helps explain what the coefficient signifies. Suppose that we compare an area that was 20% Black to one that was 80% Black. The coefficient means that there would be 3.73 more roadblocks per 1,000 citizens on average in the area that was 80% Black.³¹ To put that into context, the average census tract in Madison County had about 5,000 people per year during the relevant period. For such an average census tract, if the percentage of Black residents is 80% instead of 20%, my model predicts that there will be over 18 more roadblocks per year (3.73 more roadblocks per 1,000 people is 18.65 total roadblocks), or about 112 more roadblocks in total over the 6 years of data I analyze."³²

²⁹ Dr. Steward makes another, unrelated, math error in the example he presents. He describes a census tract where the share of the population that is Black grows by one percentage point per year. To calculate the expected time it would take to generate an additional roadblock he erroneously divides 1 by 0.06, the effect of a one-point increase in the Black population. This calculation actually provides the length of time it would take to generate an extra roadblock per 1,000 people if the Black population increased by one point, once, and then remained at that level for 16 years (e.g. if the Black population increased from 50 to 51 percent and remained at 51 percent). If the Black population increased one point *each year*, as Dr. Steward describes in his example, the first year would have 0.06 additional roadblocks per 1,000 people. However, in the second year, the Black population would increase by an additional percentage point and would be two percentage points higher than in the base year resulting in approximately $0.06 \times 2 = 0.12$ roadblocks per 1,000 people in the second year alone. The result over 16 years would be more than 8 additional roadblocks per 1,000 people. The estimated coefficient suggests an average census tract, with a population of 5,000, would experience an increase of over 42 roadblocks over the 16-year period, not one roadblock as Dr. Steward claims. See workpaper.

³⁰ Ricchetti Report, ¶¶ 33, 46.

³¹ The effect of moving from an area that was 20% Black to one that was 80% Black in my model is equal to $(80-20) \times 0.06218$, which equals 3.7308.

³² Ricchetti Report, ¶ 46.

26. Third, Dr. Steward's errors in interpreting the race coefficient also lead him to make the erroneous statement that the effect of DUIs is 20 times greater than that of race.³³ When comparing the relative magnitude of two distinct coefficients, it is well recognized that it is important to make an "apples to apples" comparison in terms of units and effect size. The racial breakdown of the population and the number of DUIs per 1,000 people operate on different scales, and have very different underlying characteristics. A common approach for doing this is to ask what is the effect of changing different factors by one standard deviation. When I do this basic scaling exercise, the effect of DUIs is not 20 times greater – it is about 2 times greater.³⁴ Another related measure, which is favored by economists for being "unitless" – that is, for allowing natural comparisons across different types of different variables, regardless of their scales, is called "elasticity." When I compare the elasticities of DUIs and race in my model of roadblock placement, the effect of DUIs is only 1.16 times greater.³⁵

27. Finally, Dr. Steward does not offer an explanation or citation for his apparent contention that only the single variable that is the greatest in magnitude can have explanatory significance.³⁶ As I explain below, the purpose of a model like mine is to test whether race has a significant effect after accounting for non-race factors that might affect roadblocks. This is a common methodology in academic papers assessing racial disparities in outcomes. Dr. Steward's contention is similar to saying that because income is a well-known factor than can explain lending rates, race cannot be a significant factor as well. There is nothing to prevent both from being true, and any such claim would stand in direct contrast to the literature.³⁷

2.4. The general methodology I use has been used in published papers studying racial profiling, and in papers studying discrimination more generally

28. In an attempt to support his claims that my model is flawed, Dr. Steward asserts that my methodology is not used in the literature on policing and crime.³⁸

³³ Steward Report, ¶ 20.

³⁴ See workpaper.

³⁵ See workpaper.

³⁶ The supporting analysis Dr. Steward appears to offer on this point is at ¶¶ 59–61 of his report. There Dr. Steward presents analysis showing a relationship between roadblocks and DUIs. Such a relationship, however, does not preclude the possibility of an effect of the share of population that is Black on roadblock frequency, controlling for DUIs.

³⁷ Rougeau, Vincent D. and Keith N. Hylton, "Lending Discrimination: Economic Theory, Econometric Evidence, and the Community Reinvestment Act," *The Georgetown Law Journal*, 85(237), 1996, p. 290.

³⁸ Steward Report, ¶¶ 38–39.

Dr. Steward makes a few claims about how and why my model purportedly does not fit into the academic literature. I address these claims below, and show that they are inconsistent with the literature.

2.4.1. The model I use has been used in the academic literature and accepted by Courts

29. First, Dr. Steward suggests that analyzing differences in crime across neighborhoods with different racial breakdowns is somehow non-standard or not accepted.³⁹ This claim is simply untrue.

30. A leading example of this methodology can be seen in a set of papers by Prof. Jeffrey Fagan of Columbia University and his co-authors that analyze whether New York City's "Stop, Question, and Frisk" program ("SQF") was used more heavily in minority neighborhoods.⁴⁰ In two different papers, Prof. Fagan and his co-authors build a statistical model of the frequency and location of the SQF program that has the same general methodological structure as my model of the frequency and location of roadblocks. Specifically, they include counts of SQF encounters at the precinct level as their dependent variable (just as the dependent variable in my model is counts of roadblocks at the census tract level). They then include controls for the direct measures of crime that SQF seeks to regulate (just as I include controls for the frequency of DUI and traffic violations variables). Further, they also include controls for certain characteristics of neighborhood *residents* (just as I do). Finally their main variable of interest is a variable measuring the share of Black residents in a given precinct and, just as in my model, they examine whether the coefficient on the share of Black residents is statistically significant, after controlling for crime in the neighborhood.⁴¹ In

³⁹ Steward Report, ¶ 47.

⁴⁰ Fagan, Jeffrey. et al., "Street Stops and Broken Windows Revisited: The Demography and Logic of Proactive Policing in a Safe and Changing City," Stephen K. Rice, and Michael D. White, (Eds.), *Race, Ethnicity, and Policing: New and Essential Readings*, New York University Press, New York and London, 2009, pp. 309–348; Gelman, Andrew et al., "An Analysis of the New York City Police Department's 'Stop-and-Frisk' Policy in the Context of Claims of Racial Bias," *Journal of American Statistical Association*, 109(479), pp. 813–823. One of Fagan's co-authors in this work is Andrew Gelman, one of the preeminent statisticians in the field, who has received the Outstanding Statistical Application award from the American Statistical Association (the award for best article published in the *American Political Science Review*) and the Council of Presidents of Statistical Societies award for outstanding contributions by a person under the age of 40.

⁴¹ It is worth noting that rather than normalizing their variables by population and using an OLS regression, Prof. Fagan and his colleagues include population as a control variable and use a Poisson regression. These two approaches are

addition to being published in academic journals, Prof. Fagan's model was relied on by Courts in *Floyd et al. v. the City of New York*, including specifically his analysis of how SQF varied with the share of residents who were Black.⁴²

31. This same methodological approach has been used in published academic papers to examine how a variety of different economic outcomes differ between neighborhoods with different racial compositions, while controlling for relevant non-race factors that affect the outcomes of interest. For example, empirical research on the possibility of "redlining" (i.e., banks offering different terms on mortgages in Black neighborhoods, even after controlling for non-race factors) uses the same statistical model to assess how lending in different neighborhoods vary with the population of the neighborhood that is Black, controlling for other factors.⁴³ There is also a literature that examines how the racial composition of different neighborhoods affects schooling and employment outcomes, including papers by top economists like David Card, Ed Glaeser, Raj Chetty, and Larry Katz in top peer-reviewed journals.⁴⁴ These papers also use the same general statistical approach of comparing outcomes across geographic areas with different racial compositions.

closely related, as they both control for population – they simply use a slightly different approach. As shown in Exhibit 4, I have run my model using a Poisson regression as Prof. Fagan does, and it yields the same conclusion as my model.

⁴² Opinion and Order, *Floyd et al. v. the City of New York*, 5/16/2012, pp. 6–7.

⁴³ Rougeau, Vincent D. and Keith N. Hylton, "Lending Discrimination: Economic Theory, Econometric Evidence, and the Community Reinvestment Act," *The Georgetown Law Journal*, 85(237), 1996, pp. 237–292, 269–270 ("The studies we will examine use regression analysis to test for discrimination in lending. This is the most powerful method of testing for discrimination in a sample of lending decisions, because it allows the researcher to isolate the influence of each factor on the decision to lend. A typical regression model might specify the total dollar amount of residential loans in a geographic market as a linear function of several variables, such as the average income of residents and the percentage of minority residents. Thus, if L = total loans in neighborhood j ($j = 1, \dots, N$, where N is the number of neighborhoods), I = average income in neighborhood j , and R = percentage of minority residents in neighborhood j , a regression model would specify $L = b_1I + b_2R + e$, where b_1 and b_2 are coefficients and e is a random error. If the coefficient on R , b_2 , is negative and statistically significant, then the data indicate that if one holds fixed the level of average neighborhood income, neighborhoods with high minority percentages receive less credit. If one believes that average neighborhood income should account for differences in the level of total lending to communities, with the combination of other influences having an essentially random influence, then this would be taken as evidence of discrimination.").

⁴⁴ See for example, Card, David and Jesse Rothstein, "Racial Segregation and the Black-White Test Score Gap," *Journal of Public Economics*, 91(11 – 12), 2007, pp. 2158 – 2184; Cutler, David M. and Edward L. Glaeser, "Are Ghettos Good or Bad?" *Quarterly Journal of Economics*, 112(3), 1997, pp. 827–872; and Chetty, Raj, Nathaniel Hendren, and Lawrence F. Katz, "The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment," *American Economic Review*, 106(4), 2016, pp. 855–902. All three papers use census tracts.

32. More generally, as I explained in my first report, the type of multiple regression analysis I use in my analysis that attempts to isolate the effect of race separately from non-race factors is a widely accepted and common statistical technique in both academia and litigation for assessing the possibility of discrimination in a variety of settings (e.g., hiring, wages, and mortgage lending).⁴⁵ Courts have relied on multiple regression analysis in a variety of discrimination matters. For example, the Federal Judicial Center's *Reference Manual for Scientific Evidence* (a document designed to aid federal judges in assessing scientific evidence) dedicates an entire chapter to multiple regression analysis, including applications to questions of discrimination.⁴⁶ Regression analysis is a useful tool to assess claims of discrimination precisely because it allows a researcher to control for relevant factors in the available data that affect the outcome of interest (e.g., the behavior of motorists) in order to more reliably isolate the effect of the variable on which there is alleged discrimination (e.g., race, gender, age).

33. In sum, the type of regression analysis I use in my report has (a) been used in academic papers to directly test whether policing differs with the residential population of different neighborhoods (after controlling for crime), (b) been used in a wide variety of academic papers analyzing questions of race and other economic outcomes, and (c) been relied on by Courts in cases involving claims of discrimination in a variety of contexts.

2.4.2. Use of census tract data, and other geographic data, is standard in the academic literature

⁴⁵ Rubinfeld, Daniel L., "Reference Guide on Multiple Regression," *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, the National Academies Press, Washington, D.C., 2011, pp. 312–317; Altonji, Joseph G., and Rebecca M. Blank, "Race and Gender in the Labor Market," Ashenfelter, Orley David C., Card, (Eds.), *Handbook of Labor Economics*, 3, 1999; Blau, Francine D., and Lawrence M. Kahn, "Gender Differences in Pay," *Journal of Economic Perspectives*, 14(4), 2000, pp. 75–99; Rougeau, Vincent D. and Keith N. Hylton, "Lending Discrimination: Economic Theory, Econometric Evidence, and the Community Reinvestment Act," *The Georgetown Law Journal*, 85(237), 1996, pp. 237–294, 269-270.

⁴⁶ Rubinfeld, Daniel L., "Reference Guide on Multiple Regression," *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, the National Academies Press, Washington, D.C., 2011, pp. 305–307 ("Regression analysis has been used most frequently in cases of sex and race discrimination, antitrust violations, and cases involving class certification.").

34. In addition to arguing that my use of racial breakdown of residents at the census tract-level is not accepted methodology, Dr. Steward also claims that the fact that my analysis is conducted at the census tract level is problematic. One reason for this critique is that the racial distribution *within a census* tract can vary.⁴⁷ This critique by Dr. Steward is at odds with the large literature in economics that routinely analyzes data across different geographic units to measure the correlations of key variables. This type of analysis is a widely accepted methodology for understanding why different neighborhoods, cities, states, and/or regions have different outcomes and experiences. As one widely used textbook notes, “Often the data used in empirical economics are at the city or county level.”⁴⁸

35. This literature includes numerous analyses of crime and policing across geographic areas. For example, as already discussed above, Prof. Fagan’s work has this feature. More generally, there is a large body of academic research that uses differences in crime activity and policing activity across different geographical units (cities, counties, etc.) to understand the relationships between crime, policing and other variables.⁴⁹ In fact, I understand Dr. Steward himself has conducted analysis across much larger geographic regions in prior expert work on crime and race.⁵⁰

36. The use of census tracts in particular is also accepted in the literature. A variety of published papers in top journals leverage census tract data to analyze how different economic outcomes vary across neighborhoods based on the racial composition of those neighborhoods, and other socioeconomic factors.⁵¹ This research includes several papers analyzing an intervention called the MTO (Moving to Opportunity) program conducted by the U.S. Department of Housing and Urban Development, which moved a set of children from relatively high

⁴⁷ Steward Report, ¶¶ 43–46.

⁴⁸ Wooldridge, Jeffrey M., *Introductory Econometrics: A Modern Approach*, 5th Edition, South-Western Cengage Learning, Mason, Ohio, 2012, p. 689.

⁴⁹ Chalfin, Aaron, and Justin McCrary, “Criminal Deterrence: A Review of the Literature,” *Journal of Economic Literature*, 55(1), 2017, pp 5–48, offers a summary of the literature. See also the Rebuttal Expert Report of Justin McCrary, Ph.D., July 2, 2018 (“McCrary Report”)

⁵⁰ Opposition to Defendants’ Joint Motion to Exclude Dwight Steward, Ph.D., as an Expert Witness, *Kelly v. Paschall*, February 24, 2005.

⁵¹ See for example, Card, David and Jesse Rothstein, “Racial Segregation and the Black-White Test Score Gap,” *Journal of Public Economics*, 91(11–12), 2007, pp. 2158–2184; Cutler, David M. and Edward L. Glaeser, “Are Ghettos Good or Bad?” *Quarterly Journal of Economics*, 112(3), 1997, pp. 827–872; and Chetty, Raj, Nathaniel Hendren, and Lawrence F. Katz, “The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment,” *American Economic Review*, 106(4), 2016, pp. 855–902.

poverty neighborhoods to relatively low poverty neighborhoods, and then tracked their successes over time relative to a control group that did not move. This study identified high poverty neighborhoods with census tracts.

37. All of the papers discussed above have the same feature in their data that Dr. Steward criticizes in my analysis. They include variables that are measured across geographic units, such as census tract, county, city-level, etc., and those variables have values that vary across sub-areas of whatever geographic unit is being analyzed. Yet all of these papers are published in peer-reviewed journals. It is well understood in the academic literature that this type of data introduces a type of white noise, which is commonly referred to as measurement error. This feature of the data is understood to, if anything, make it *more difficult* to find a statistically significant correlation, as the additional noise tends to attenuate the estimated statistical relationship between difference variables. In Section 3 below, I discuss this issue in more detail.

38. Dr. Steward's claim that this issue makes my analysis unreliable is, thus, inconsistent with basic econometric principles and inconsistent with accepted practice in the scientific literature.

2.5. Dr. Steward overstates the role of factors not included in my model

39. Dr. Steward also argues that unobserved factors not included in my model could explain the estimated effect that the model currently attributes to the racial composition of the census tract. Dr. Steward alleges that I did not consider standard approaches to test the potential effects of omitted factors.⁵² There are a few points worth noting here.

40. As discussed in my first report, it is widely recognized that R-Squared is a statistic that helps measure how well the control variables in the regression model explain the frequency of roadblocks across the different census tracts.⁵³ The R-

⁵² Steward Report, ¶¶ 74–75.

⁵³ Rubinfield, Daniel L., "Reference Guide on Multiple Regression," *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, the National Academies Press, Washington, D.C., 2011, p. 316 ("In general, the more complete the explained relationship between the included explanatory variables and the dependent variable, the more precise the results.").

Squared of 0.65 in my model is considered to be a large R-Squared. For example, as I noted in my first report, one popular econometrics textbook states that, “in terms of the values one normally encounters in cross sections, an R-Squared of 0.5 is relatively high.”⁵⁴

41. Further, a widely accepted practice for testing whether the results of a regression may be sensitive to the addition of omitted variables is to run different sensitivity analyses and assess the overall pattern of the coefficient as more variables are added, and as other changes are made to the model.⁵⁵ As detailed in Appendix C Exhibits 1-6 and in my workpapers, I have now run more than 50 sensitivities of my model. Across all such sensitivities, the coefficients are statistically significant and stable. Further, the addition of more variables does not decrease the effect of race.

42. Note that the sensitivity results are unsurprising because we already control for what Dr. Steward agrees is the most important determinant of roadblocks. Adding other factors to the regression should not be expected to change the results once the key factor is considered, and the data bears this out. Indeed, Dr. Steward’s own sensitivity analysis in which he adds control variables for bars and restaurants supports this conclusion. As shown above, that model finds that the effect is, if anything, a bit larger in magnitude than my original model.

2.6. Dr. Steward misrepresents my descriptive analysis, and incorrectly claims that I do not perform tests of statistical significance

43. Dr. Steward also criticizes the summary of data that I present in Section 4.1 of my report. Dr. Steward identifies two issues with that analysis, each of which I discuss below. In making these criticisms, Dr. Steward demonstrates a basic misunderstanding of the purpose of summary data.

⁵⁴ Greene, William H., *Econometric Analysis*, 6th Edition, Pearson Prentice Hall, Upper Saddle River, New Jersey, 2008, p. 38.

⁵⁵ Oster, Emily, “Unobservable Selection and Coefficient Stability: Theory and Evolution” NBER Working Paper, August 9, 2016, p. 2 (“A common approach in these situations [wherein observed controls are an incomplete proxy for the true omitted variable or variables] is to explore the sensitivity of treatment effects to the inclusion of observed controls. If a coefficient is stable after inclusion of the observed controls, this is taken as a sign that omitted variable bias is limited.”).

44. Beginning a statistical analysis with a descriptive overview of the patterns in key variables is standard in academic papers. Indeed, basic statistics and econometrics textbooks note that it is common to start an analysis with a descriptive summary of key variables before developing a formal statistical test.⁵⁶ The fact that Dr. Steward focuses much of his criticism on basic descriptive statistics rather than on the formal statistical tests in my regression model is atypical in academic research, as the regression model is the formal statistical method for testing the hypothesis while controlling for other factors.⁵⁷

45. One of Dr. Steward's criticisms is that I did not present a test of statistical significance in that section.⁵⁸ This statement suggests that Dr. Steward misunderstands the purpose of the data summary. As I explicitly stated in my initial report, the purpose of the data summary was not to perform a statistical test, but rather to highlight the general patterns in the data. As Dr. Steward himself discusses in his report, it is necessary to control for other factors which can influence roadblock placement prior to testing whether any effect can be attributed to race.⁵⁹ As is appropriate and consistent with this standard methodology, I do in fact perform a test of statistical significance in the context of my regression model that controls for driving behavior and other factors. The summary of the data presented in Section 4.1 is meant only to highlight general patterns in the data that inform my regression analysis. In fact, I discussed this issue clearly in my initial report.

“I start my analysis in Section 4.1 with a set of descriptive analyses that highlight the general patterns in the location and frequency of

⁵⁶ Moore, D., and McCabe, G., *Introduction to the Practice of Statistics*, 5th Edition, W.H. Freeman and Company, New York, 2004, at p. 7 (“Statistical tools and ideas help us examine data in order to describe their main features. This examination is called exploratory data analysis. Like an explorer crossing unknown lands, we want first to simply describe what we see.”); See also Kennedy, Peter, *A Guide to Econometrics*, 6th Edition, Blackwell Publishing, 2008, p. 364; Wooldridge, Jeffrey M., *Introductory Econometrics: A Modern Approach*, 5th Edition, South-Western Cengage Learning, Mason, Ohio, 2012, p. 690.

⁵⁷ Wooldridge, Jeffrey M., *Introductory Econometrics: A Modern Approach*, 5th Edition, South-Western Cengage Learning, Mason, Ohio, 2012, p. 68 (“Multiple regression analysis...allows us to *explicitly* control for many other factors that simultaneously affect the dependent variable. This is important both for testing economic theories and for evaluating policy effects when we must rely on nonexperimental data. The multiple regression model is still the most widely used vehicle for empirical analysis in economics and other social sciences”).

⁵⁸ Steward Report, ¶ 64.

⁵⁹ Steward Report, ¶ 48.

roadblocks across the 21 different census tracts in Madison County. I show that the frequency of roadblocks is generally higher in census tracts with a substantially higher percentage of Black residents. In Section 4.2, I then present the findings of my regression analysis, where I formally test whether the frequency of roadblocks is higher in census tracts with a higher percentage of Black residents, controlling for other factors that are predictive of differences in traffic behavior.”⁶⁰

46. Dr. Steward also argues that my grouping of the census tracts into two groups (those with a relatively high share of Black residents and those with a relatively low share) somehow makes my analysis unreliable. In fact, Dr. Steward asserts that I assume “racial bias appears when a census tract achieves an African-American population of 46.2%.”⁶¹ This argument is incorrect and again misrepresents how my analysis works. While it is true that I group the census tracts into two groups when summarizing the data to highlight the fact that there is large variation in the racial population across the county, in the formal statistical tests that I run using my regression model in Section 4.2, I *do not* group the census tracts in this manner. Thus, none of my conclusions depend in *any way* on the grouping of census tracts that I present as a descriptive device. Further, Dr. Steward’s various re-groupings of my descriptive analysis do not in any way rebut (or even address) the findings from my regression analysis, which are the appropriate and rigorous way to test for a general relationship between roadblocks and the racial breakdown across census tracts (controlling for other factors).

3. DR. STEWARD’S ANALYSIS OF THE GEOCODING DATA IGNORES BASIC ECONOMETRIC PRINCIPLES

47. In addition to commenting on my statistical methodology, Dr. Steward (as well as Mr. Funderburk) also makes several claims about the data I use on the location of roadblocks. They point in particular to three facts about the location data produced by MCSD. First, they note that it is common for MCSD to report roadblocks based on intersections rather than exact addresses.⁶² Second, they note

⁶⁰ Ricchetti Report, ¶¶ 35–36.

⁶¹ Steward Report, ¶ 35.

⁶² Steward Report, ¶ 26; Funderburk Report, ¶¶ 22, 44.

that a set of roadblocks were established on the boundaries of census tracts.⁶³ Third, they note that some of the specific address information produced by MCSD does not line up with physical locations where a roadblock could reasonably occur.⁶⁴

48. In this section, I explain how Dr. Steward's and Mr. Funderburk's critiques of the roadblock data ignore the relevant question from a statistical point of view: do these potential data issues have any meaningful effect on the key findings from my regression analysis? As I explain below, using basic econometric principles of measurement error that I discussed above, there are well-accepted methods for testing this question. Despite these well-accepted methods, neither Dr. Steward nor Mr. Funderburk offer *any tests* to show that the existence of roadblocks on census boundaries affect my conclusions. As I show, when I run such tests I find that my findings are not sensitive to the data issues they describe. Specifically, as I show below, even if we employ a standard technique of removing data points with potential measurement issues, the general findings of my regression model remain unchanged and the precision of my model actually increases – a result that is consistent with the large academic literature on measurement error. In fact, even if I make the assumption that every roadblock on the boundary was in fact set up in the census tract it borders with a relatively *lower share* of Black residents, my regression still finds that roadblock frequency increases in census tracts with a higher share of Black residents.

49. While Mr. Funderburk and Dr. Steward both suggest that this measurement challenge renders my analysis unreliable, it is striking that neither of them offer any statistical test that demonstrates that this measurement challenge affects my results in any meaningful way. As I explain below, making such an argument without running a statistical test for whether it matters is not consistent with standard methods described in econometrics textbooks.⁶⁵ Following standard

⁶³ See for example, Steward Report, ¶¶ 30–31, 41; Funderburk Report, ¶ 48.

⁶⁴ See for example, Steward Report, ¶¶ 28–29; Funderburk Report, ¶ 48.

⁶⁵ Wooldridge, Jeffrey M., *Introductory Econometrics: A Modern Approach*, 5th Edition, South-Western Cengage Learning, Mason, Ohio, 2012, pp. 684–685. (“If your model has some potential misspecification, such as omitted variables, and you use OLS, you should attempt some sort of misspecification analysis of the kinds we discussed in Chapters 3 and 5. Can you determine, based on reasonable assumptions, the direction of any bias in the estimators.... Good papers in the empirical social sciences contain sensitivity analysis. Broadly, this means you estimate your original model and modify it in ways that seem reasonable. Hopefully, the important conclusions do not change.”).

methodological practice, I have tested whether the presence of measurement error biases my conclusions in any way. It does not.

50. Finally, as explained in Dr. Frontiera's report, the geocoding approach used in my first report is a standard approach and consistent with best practices. Additionally, the criticisms of Mr. Funderburk are derived from a non-random sample and caused by poor data quality in the data produced by MCSD, rather than geocoding methods.⁶⁶

3.1. Measurement error is a well-recognized feature of many regression models, and is only a problem if the error is correlated with the variable of interest

51. The main thrust of Mr. Funderburk and Dr. Steward's concern about roadblock data is that some of the roadblocks are near the boundary between two census tracts and may be incorrectly assigned to the wrong census tract based on the information provided in MCSD database.⁶⁷ This concern amounts to a very standard methodological issue that is widely studied in econometrics – measurement error.⁶⁸

52. As is well understood in the scientific literature (and discussed in introductory econometrics textbooks), the key question in such a situation is: how does the presence of such noise in the data affect the regression coefficients? This question is one of the most standard methodological questions in econometrics because it is common for data used in social science to be imprecisely measured.

53. For example, one academic paper on empirical methods in econometric analysis, written by Alan Krueger, former Chair of the Counsel of Economic Advisors to the President, and Josh Angrist (MIT) notes that: “[I]t is probably

⁶⁶ Rebuttal Expert Report of Patricia Frontiera, Ph.D., July 2, 2018 (“Frontiera Report”), ¶¶ 9, 61.

⁶⁷ Steward Report, ¶¶ 31, 41; Funderburk Report, ¶¶ 16, 51.

⁶⁸ It is worth noting that, in his deposition testimony, Dr. Steward did not accurately define measurement error. Dwight Steward Deposition, pp. 186:17–187:7. (“Q. And what is your understanding of that term [measurement error]? A. Measurement error is not data error. Measurement error is a completely statistical term. And again, it has to do with a tool, not with the data. Measurement error just has to do with accounting for the fact that there are going to be some things you can't measure. Like, the classic example is fire in the belly when you're looking at salary. You're going to have some people that just work really hard and other people that don't really hard. But on average, when you're doing a salary analysis, it balances out.”)

best to think of data as routinely being mismeasured. Although few economists consider measurement error the most exciting research topic in economics, it can be of much greater practical significance than several hot issues.”⁶⁹ In fact, the *Reference Manual on Scientific Evidence* – a treatise designed to address methodological issues that arise in expert testimony – also discusses the issue of measurement error, and how to test whether it affects a model’s results.⁷⁰

54. Mathematically, measurement error is expressed as follows:

$$\text{Measured Roadblocks}_i = \text{Roadblocks}_i + u_i$$

55. The key parameter in the above equation is u_i , which is referred to as measurement error in the econometrics literature. As explained in econometrics textbooks, in order to understand whether the presence of u_i presents any problems for a regression analysis like mine, the key question is whether u_i is correlated in a very specific way with the race variable in my model. For example, it could be that the existence of u_i causes my model to *understate* the number of roadblocks in census tracts with a high share of Black residents. If that were the case, my model would be conservative. On the other hand, it could be that the existence of u_i causes my model to *overstate* the number of roadblocks in census tracts with a high share of Black residents, which would make my model overstate the correlation between race and roadblocks. There are several key insights in the scientific literature about measurement error that help explain why it does not typically pose a problem for regression analysis.

56. First, when measurement error is generated by data entry issues (i.e., the person entering the data into the database does not enter complete information), typically the measurement error represents nothing more than random noise. In this situation, measurement error ***does not lead to any bias in the regression analysis***. The only effect is to decrease the precision of the regression coefficients, making it *harder* to find a significant effect. For example, a widely used textbook in econometrics describes these issues in the following passage:

⁶⁹ Angrist, Joshua D., and Alan B. Krueger, "Empirical Strategies in Labor Economics," Orley C. Ashenfelter and David Card, (Eds.), *Handbook of Labor Economics*, 1999, p. 1340–1341.

⁷⁰ Rubinfeld, Daniel L., "Reference Guide on Multiple Regression," *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, the National Academies Press, Washington, D.C., 2011, pp. 327–328.

“The usual assumption is that the measurement error in [a dependent variable] is statistically independent of each explanatory variable. ***If this is true, then the OLS estimators [the regression coefficients] are unbiased and consistent.*** Further, the usual OLS inference procedures (*t*, *F*, *LM* statistics are valid)... measurement error in the dependent variable results in a larger variance than when no error occurs; this, of course, results in larger variances of the OLS estimators.... The bottom line is that, ***if the measurement error is uncorrelated with the independent variables, then OLS estimation has good properties.***”⁷¹ (emphasis added)

57. Krueger and Angrist describe the issue as follows:

“What are the implications of classical measurement error?... If Y_i [the dependent variable] is regressed on one or more correctly-measured explanatory variables, the expected value of the coefficient estimates is not affected by the presence of the measurement error. ***Classical measurement error in the dependent variable leads to less precise estimates - because the errors will inflate the standard error of the regression - but does not bias the coefficient estimates.***”⁷² (emphasis added)

58. Further, when measurement error is present in an independent variable (as Dr. Steward claims of my race variable), ***the main effect of measurement error is attenuate, or shrink, the size of the coefficient of interest.*** For example, the *Reference Manual on Scientific Evidence* notes the following:

“[I]f one or more independent variables are measured with error, the corresponding parameter estimates are likely to be biased, typically toward zero (and other coefficient estimates are likely to be biased as well). To understand why, suppose that the dependent variable, salary, is measured without error, and the explanatory variable, experience, is

⁷¹ Wooldridge, Jeffery M., *Introductory Econometrics: A Modern Approach*, 5th Edition, South-Western Cengage Learning, Mason, Ohio, 2012, pp. 318–319.

⁷² Angrist, Joshua D., and Alan B. Krueger, “Empirical Strategies in Labor Economics,” Orley C. Ashenfelter and David Card (Eds.), *Handbook of Labor Economics*, 1999. p. 1340

subject to measurement error. (Seniority or years of experience should be accurate, but the type of experience is subject to error, because applicants may overstate previous job responsibilities.) As the measurement error increases, the estimated parameter associated with the experience variable will tend toward zero, that is, eventually, there will be no relationship between salary and experience.”⁷³

59. In other words, the typical effect of the measurement error that Dr. Steward and Mr. Funderburk describe in my analysis is to increase the standard errors of the regression coefficients, making it harder for my analysis to find statistical significance, and, thus, if anything, **shrink** the effect of race, making my analysis more conservative. As I show in the next sub-section, a variety of sensitivity analyses confirm that any imprecision in the measurement of roadblocks per census tract have no effect on my ultimate conclusions.

60. Before moving on to my sensitivity analysis, it is worth noting one other data issue that Mr. Funderburk and Dr. Steward raise. Both point out that many of the roadblocks *not* on the boundary of the census blocks are located at intersections rather than exact addresses.⁷⁴ As Dr. Frontiera explains, this data feature is common in geocoding and does not present a problem.⁷⁵ As I discuss below, to demonstrate that such concerns are not a problem for my analysis I have also hand-entered each roadblock and tested whether my findings change. They do not.

3.2. When I apply standard sensitivity tests for roadblocks that are near the boundary of census tracts, my findings are unchanged

61. In response to the criticisms of Mr. Funderburk and Dr. Steward, I perform several analyses, which can quantify the implications of their criticisms on my model (notably, Dr. Steward and Mr. Funderburk attempt no such calculations on their own).

⁷³ Rubinfield, Daniel L., “Reference Guide on Multiple Regression,” *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, the National Academies Press, Washington, D.C., 2011, pp. 327; See also Angrist, Joshua D., and Alan B. Krueger, “Empirical Strategies in Labor Economics,” Orley C. Ashenfelter and David Card (Eds.), *Handbook of Labor Economics*, 1999. p. 1340.

⁷⁴ Steward Report, ¶ 26.; Funderburk Report, ¶¶ 22, 44.

⁷⁵ Frontiera Report, ¶¶ 29-31.

62. A standard and well-accepted way to test whether measurement error affects the results of a regression model is to run sensitivity tests of the main model by removing the data points that are likely to have measurement error. For example, the *Reference Manual on Scientific Evidence* notes the following:

“In general, it is important to explore the reasons for unusual data points. If the source is an error in recording data, the appropriate corrections can be made. If all the unusual data points have certain characteristics in common (e.g., they all are associated with a supervisor who consistently gives high ratings in an equal pay case), the regression model should be modified appropriately. One generally useful diagnostic technique is to determine to what extent the estimated parameter changes as each data point in the regression analysis is dropped from the sample.”⁷⁶

63. The literature also refers to this technique as “trimming.”⁷⁷ One common example of trimming that has been used in the academic literature occurs when economists analyze self-reported income. It is well-known that some subset of people will significantly over-report and/or under-report their income for a variety of reasons. In order to ensure that this type of measurement error does not affect statistical analyses of wages, academics often times remove the highest and lowest wage values from their data because these data points are the ones most likely to have measurement error.⁷⁸ Papers have also applied trimming techniques to potential measurement error in geographic boundaries.⁷⁹

⁷⁶ Rubinfeld, Daniel L., “Reference Guide on Multiple Regression,” *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, the National Academies Press, Washington, D.C., 2011, pp. 327.

⁷⁷ Angrist, Joshua D., and Alan B. Krueger, “Empirical Strategies in Labor Economics,” *Handbook of Labor Economics*, 1999. Orley C. Ashenfelter and David Card (Eds.), p. 1347 (“Researchers have employed a variety of ‘trimming’ techniques to try to minimize the effects of observations that may have been misreported.”).

⁷⁸ Angrist, Joshua D., and Alan B. Krueger, “Empirical Strategies in Labor Economics,” Orley C. Ashenfelter and David Card, (Eds.), *Handbook of Labor Economics*, 1999, pp. 1347–1349.

⁷⁹ For example, in a paper that analyzed the economics of health care privatization, the authors analyzed the effectiveness of Medicare Advantage relative to fee-for-service policies for patients who used hospitals in NY State. The data they analyzed could not account for the fact that some patients that lived in NY State might cross the border to use hospitals in other states. To test that their findings were not sensitive to this issue, they ran their model removing beneficiaries that lived near the state boundary. See Duggan, Mark, Jonathan Gruber, and Boris Vabson, “The Consequences of Health Care Privatization: Evidence from Medicare Advantage Exits,” *American Economic Journal: Economic Policy*, 10(1), 2018, p. 169. (“A final concern is that our inpatient data is limited to New York State only, and fails to track visits to hospitals in surrounding states. This could result in biased estimates, in the event that MA enrollees in New York have

64. An even stronger way to test whether the existence of roadblocks on the boundary drives my findings is to assume that every roadblock on the boundary was assigned to the census tract that it borders that has the lowest share of Black residents. In other words, it is possible to see if the statistically significant relationship between roadblock frequency and the share of the population that is Black holds even if every roadblock on the boundary was in fact in a census tract with the highest white share. This directly tests the concerns of Dr. Steward and Mr. Funderburk that roadblocks that are in census tracts with a relatively high share of Black residents are being placed there in error.

65. To conduct these sensitivities, my team hand-coded every roadblock and DUI in the CAD data under my supervision. That is, using Google Maps, my team reviewed every individual address or intersection and identified to which census tract these incidents belong. I further identified cases where such incidents could ostensibly be on the border between multiple census tracts. These steps both allow for a direct test of whether any measurement error in my original analysis drove my results.

66. Exhibits 5 and 6 present results from these sensitivity analyses. A clear pattern emerges – my main findings hold in all analyses. The sensitivities are as follows:

- In Exhibit 5, I remove from my analysis the roadblocks that, based on the GIS coding in my original report, are within 20 meters of a census tract border. As is clear, the coefficient on share of population that is Black remains statistically significant. I also perform sensitivities to this model to show that Dr. Steward's other criticisms of my original model related to simultaneity bias, normalizing variables by population, and including allegedly irrelevant control variables do not affect my findings. In all cases, my results are unchanged.⁸⁰
- In Exhibit 6, I keep all of the roadblocks that, by manual inspection, appear to be on the boundary between two census tracts, and assign

differential rates of out-of-state inpatient usage, relative to those in FFS. We perform two different robustness checks, which involve the exclusion of populations more likely to use out-of-state hospitals. In one test, we exclude beneficiaries who live in exit counties and simultaneously reside within ten miles of a state border. In another test, we take a more systematic approach to identifying potential out-of-state hospital users by leveraging hospital service area (HSA) definitions; we exclude those living in exit counties AND simultaneously living in a zip code that is in a non-NY HSA.”)

⁸⁰ See workpaper.

them to the census tract that they border **that has the lowest share of Black residents**. As is clear, even when I make this assumption, my results hold. I again perform sensitivities to show that Dr. Steward's other criticisms my original model related to simultaneity bias, normalizing variables by population, and including allegedly irrelevant control variables do not affect my findings. In all cases, my results are unchanged.⁸¹

67. The fact that my model finds statistically significant and positive coefficients on the share of residents who are Black *across all sensitivities* demonstrates that my findings are unaffected by any imprecisions in the data due to roadblocks being on the boundary. In other words, the higher frequency of roadblocks in census tracts with a higher share of Black residents exists regardless of how the boundary roadblocks are treated.

4. CONCLUSION

68. Dr. Steward identifies a variety of critiques of my statistical model in his report, but my methodology is widely used in academic papers and by the Courts in litigation. In fact, Dr. Steward has used the same broad methodology (for example, making comparisons across geographic regions) in his own work.

69. Further, using sensitivity analyses, I have shown that the various claims Dr. Steward makes about the control variables in my model and the data have no consequence on the findings of my model. Consistent with standard methodology, I have run a wide variety of sensitivity analyses and robustness checks to my model (I have run over 50 different specifications of my model), and *all* of them support the same conclusion. The fact Dr. Steward has levied numerous criticisms of my model without even testing whether they affect the main findings of my model is inconsistent with professional standards.



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⁸¹ See workpaper.

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- Manage and conduct economic analysis for complex business litigation and regulatory matters, with specialization in antitrust, labor, class action, market manipulation and product misrepresentation matters.
- Expertise applying a wide range of empirical and theoretical methods to complicated market settings, including the application of statistical methods to analysis of large, proprietary data sets.
- Industry focus includes: retail, food and agriculture, the economics of distribution, and sports economics.

Selected Consulting Experience

- *Wage Discrimination Matter* Analyzed claims of gender discrimination. Oversaw the statistical analysis of wage and promotion patterns in internal personnel records for one of the largest employers in the world.
- *Monopsony Wage Fixing Cartel in Sports Industry* Analyzed claims that wages were capped by a sports regulatory organization. Oversaw statistical analysis of key issues.
- *Monopsony Wage Fixing Cartel in Service Industry* Analyzed claims of monopsony wage suppression in service industry. Managed and implemented statistical analysis of complex payroll records. Conducted liability and damages analysis.

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Vice President, Cornerstone Research

- *Wage Discrimination Consulting Matters* Analyzed wage and promotion patterns in internal personnel records for large private company. Implemented econometric tests.
- *Wrongful Termination Gender Discrimination Matter* Analyzed wage and job history data to assess damage claims for employees who were allegedly wrongfully terminated by employer.
- *Alleged Cartels in Dairy Industry* (*Alice H. Allen et al. v. Dairy Farmers of America, Inc., et al. and Sweetwater Valley Farm, Inc., et al., v. Dean Foods Company, et al.*) Analyzed liability, damages, and class certification issues in multiple cases alleging vertical and horizontal conspiracies, price-fixing and quantity restrictions in the dairy industry. Analyzed pricing data at all levels of the industry, including issues of pass-through. Oversaw implementation of econometric analysis.
- *Alleged Monopoly and Foreclosure in Home Recreation Industry* Assessed claims of attempted monopoly and foreclosure by large distributor of home recreation products. Developed statistical model of damages to measure alleged impact of challenged conduct.
- *Merger in Food and Agriculture Industry* Analyzed potential economic impacts of a proposed merger between two large distributors. Assessed industry structure, competitive landscape, and possible price effects.
- *Regulatory matters involving state-level alcohol laws* Analyzed the economic impact of changes to state-level laws related to the distribution of beer, wine, and liquor in one state, and retail sale of liquor in another state. Assessed the potential effect of law change on alcohol consumption, tax revenue, and relevant social and economic outcomes.
- *LIBOR Manipulation Matters* Conceptualized and managed econometric analysis to understand the effect of the alleged conduct on rate trends. Prepared findings for regulatory investigation.

9/03 – 9/07 **US Census Bureau, LEHD**

Ithaca, New York

Labor Economist

- Conducted econometric analysis related to research program on data confidentiality. Performed complex statistical modeling of key labor market outcomes. Authored internal papers and presentations.

7/99 – 7/2002 **MDRC**

New York, New York

Research Assistant

- Conducted economic and statistical analyses of the effect of welfare-to-work programs on labor market outcomes.

BRYAN RICCHETTI, Ph.D.

Vice President, Cornerstone Research

TESTIMONY

Wal-Mart Puerto Rico, Inc. v. Juan C. Zaragoza-Gomez U.S. District Court, District of Puerto Rico. Retained by counsel for Plaintiff. Analyzed statistics issue. Filed affidavit on 1/19/16, deposed, and testified at trial.

Dunmars v. Board of Trustees of Community College District No. 510 and Jorie Menclewicz U.S. District Court, Northern District of Illinois, Eastern Division. Retained by counsel for Plaintiff. Damages analysis in lost wages matter. Report filed on 3/18/16.

Scott Swanson v. Epic Systems Corporation U.S. District Court, Western District of Wisconsin. Retained by counsel for Defendant. Rebuttal of Plaintiff expert regression analysis in age discrimination matter. Report filed on 9/5/17.

Boston Chapter, NAACP, Inc., et al. v. Nancy B. Beecher et al., and Pedro Castro et al., v. Nancy B. Beecher et al., U.S. District Court, District of Massachusetts. Retained jointly by Plaintiffs and Defendants. Analysis of qualified labor pool for entry-level police and firefighters. Report filed on 10/11/17.

Winn-Dixie Stores, Inc. and Bi-Lo Holdings, LLC v. Southeast Milk, Inc., et. Al, U.S. District Court, Middle District of Florida, Jacksonville Division. Retained by counsel for Defendants. Analyzed liability and damages in alleged horizontal quantity restriction conspiracy. Report filed on 2/20/18.

Data Breach matter. Retained as statistics expert to analyze patterns of alleged data breach. Case resolved before report or testimony.

Antitrust matter. Retained to analyze procompetitive aspects of allegedly anticompetitive horizontal agreement. Case resolved before report or testimony.

ARTICLES AND PRESENTATIONS

Moderator, “The Capper Volstead Act - Lessons from the Trenches,” ABA Teleconference Panel, December 9, 2016.

Panelist, 43rd Annual Fordham Conference on Antitrust Law and Policy, Economic Workshop – “Preparing for Deposition and Dealing with *Daubert* Challenges”

Expert Witness, ABA Antitrust Spring Meetings Mock Trial, Spring 2015 (Case involved antitrust issues raised by a hypothetical college athletic association’s restrictions on amateur player compensation)

Expert Witness, Antitrust Law & Economics Institute for Federal Judges Mock Trial, October 2015 (Case involved antitrust issues raised by a hypothetical college athletic association’s restrictions on amateur player compensation)

Co-author, “Applying Econometrics to Assess Market Definition and Market Power,” *Econometrics: Legal, Practical, and Technical Issues*, American Bar Association Section of Antitrust Law.

BRYAN RICCHETTI, Ph.D.

Vice President, Cornerstone Research

Co-author, “Antitrust Impact in Indirect Purchaser Class Actions: The Need for Rigorous Analysis of Pass-Through,” in the forthcoming Spring 2015 ABA Antitrust Distribution and Franchising Committee Newsletter

“Interpreting Comcast: Judge Koh’s Decision in *Brazil v. Dole Foods*,” in the Winter 2015 ABA Agriculture and Food Committee Newsletter.

Contributor, “How Effective Are Different Welfare-to-Work Approaches? Five-Year Adult and Child Impacts for Eleven Programs.” December 2001, New York: MDRC.

Co-Author, ABA Handbook, Chapter on Pricing Regulations in the Dairy Industry, *Forthcoming*.

“Testing Disclosure Risk in the proposed SIPP-IRS-SSA Public Use Files,” *Cornell University Dissertation*, August 2007 (and submitted to U.S. Census Bureau Disclosure Review Board, November 2016).

“Turnover as a Gateway to Symmetric Information: Testing Patterns of Entry into Personnel Records,” *Cornell University Dissertation*, August 2007.

“Piece-Rates, Salary, Performance and Job Level,” *Cornell University Dissertation*, August 2007.

ACADEMIC HONORS AND AWARDS

Walter Galenson Fellowship in Labor Economics, Cornell University	Spring 2005
Scholarship Prize in Economics, Hamilton College	Spring 1998

Documents Considered by Bryan Ricchetti, Ph.D.**Legal Pleadings**

Defendants' Answer and Affirmative Defenses to the Complaint.	June 29, 2017
Opinion and Order, <i>Floyd et al. v. the City of New York</i> .	May 16, 2012
Plaintiffs' Opposition to Defendants' Joint Motion to Exclude Dwight Steward, Ph.D., as an Expert Witness, <i>Kelly v. Paschall</i> .	February 24, 2005

Expert Report

Expert Report of Bryan Ricchetti, Ph.D. with associated exhibits, appendices, and production.	March 13, 2018
Expert Report of William R. Funderburk with associated exhibits, appendices, and production.	May 8, 2018
Rebuttal Expert Report of Dwight D. Steward, Ph.D. RE: Bryan Ricchetti, Ph.D. with associated exhibits, appendices, and production.	May 8, 2018
Rebuttal Expert Report of Justin McCrary, Ph.D. with associated exhibits, appendices, and production.	July 2, 2018
Rebuttal Expert Report of Patricia Frontiera, Ph.D. with associated exhibits, appendices, and production.	July 2, 2018

Depositions

Deposition of Dwight Steward, Ph.D.	June 22, 2018
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Card, David, and Jesse Rothstein, "Racial Segregation and the Black-White Test Score Gap," <i>Journal of Public Economics</i> , 91(11-12), pp. 2158–2184.	2007
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Documents Considered by Bryan Ricchetti, Ph.D.

Kennedy, Peter, <i>A Guide to Econometrics</i> , 6 th Edition, Wiley-Blackwell, Malden, Massachusetts.	2008
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Data

American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi, Age and Sex	2012–2016
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American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi, Housing Characteristics	2012–2016
American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi, Median Household Income	2012–2016
American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi, Race	2012–2016
American Community Survey Five Year Estimates for All Places in Madison County, Mississippi, Demographic and Housing Estimates	2016
American Community Survey Five Year Estimates for All Census Tracts in Madison County, Mississippi - Geodatabase Format, Shapefiles, available at <i>U.S. Census Bureau</i> , https://www.census.gov/geo/maps-data/data/tiger-data.html .	2015
Tiger/Line Shapefiles: Places - Mississippi, available at <i>U.S. Census Bureau</i> , https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2017&layergroup=Places .	2017
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APPENDIX C: SUPPLEMENTAL ANALYSIS

Exhibit 1

Model from first report^[1]

Variable ^[2]	(1) With DUI Arrests ^[3]	(2) With Traffic Citations/Arrests ^[4]	(3) With Unemployment and Income ^[5]	(4) With Age and Vehicle Ownership ^[6]
Black Percentage of Population	0.02144	0.03193	0.06730	0.06218
standard error	0.00883	0.00921	0.01678	0.01721
p-value	0.01658	0.00073	0.00011	0.00044
Number of DUI Arrests Per 1,000 People	1.26540	1.48120	1.43700	1.38900
standard error	0.09188	0.11370	0.11650	0.12150
p-value	0.00000	0.00000	0.00000	0.00000
Number of Traffic Citations/Arrests Per 1,000 People		-0.11560	-0.08963	-0.10300
standard error		0.03797	0.03978	0.04075
p-value		0.00285	0.02606	0.01281
Median Household Income (in Thousands)			0.03174	0.02669
standard error			0.01528	0.01566
p-value			0.03994	0.09094
Unemployment Rate			-0.05076	-0.07771
standard error			0.07406	0.07727
p-value			0.49440	0.31660
Percentage of Households with At Least One Vehicle				-0.09574
standard error				0.07282
p-value				0.19120
Percentage of Population between Ages 15–24				-0.04544
standard error				0.04742
p-value				0.33980
Constant	-0.24690	-0.26490	-3.54750	7.05080
standard error	0.43940	0.42530	1.73230	7.83940
p-value	0.57520	0.53450	0.04275	0.37030
Observations	126	126	126	126
Adjusted R-Squared	0.625	0.649	0.661	0.662

Source: Master CAD Report – To Be Produced.csv; American Community Survey Five Year Estimates; US Census Bureau

Note:

[1] The dependent variable is the total number of CAD Roadblocks per 1,000 people per year by census tract.

[2] The Census Bureau has yet to release the 2013–2017 American Community Survey Five Year Estimates. Data from the 2012–2016 American Community Survey Five Year Estimates are used for observations in both 2016 and 2017.

[3] Specification (1) uses number of DUI arrests per 1,000 people per year by census tract as a control variable.

[4] Specification (2) uses number of traffic citations and arrests per 1,000 people per year by census tract as a control variable in addition to control variables used in specification (1).

[5] Specification (3) uses median household income and the unemployment rate by census tract as control variables in addition to control variables used in specification (2).

[6] Specification (4) uses the percentage of the population between 15–24 and vehicle ownership by census tract as control variables in addition to control variables used in specification (3).

Exhibit 2

Roadblock model using lagged DUIs and traffic citations^[1]

Variable ^[2]	(1) With Lagged DUI Arrests ^[3]	(2) With Lagged Traffic Citations/ Arrests ^[4]	(3) With Unemployment and Income ^[5]	(4) With Age and Vehicle Ownership ^[6]
Black Percentage of Population	0.02868	0.03902	0.07293	0.06419
standard error	0.01103	0.01176	0.02122	0.02170
p-value	0.01067	0.00126	0.00086	0.00390
Number of DUI Arrests Per 1,000 People in the Previous Year	1.22160	1.41090	1.38420	1.31510
standard error	0.10950	0.13670	0.14200	0.14730
p-value	0.00000	0.00000	0.00000	0.00000
Number of Traffic Citations/Arrests Per 1,000 People in the Previous Year		-0.10240	-0.08153	-0.10660
standard error		0.04571	0.04812	0.05011
p-value		0.02734	0.09336	0.03588
Median Household Income (in Thousands)			0.03377	0.02684
standard error			0.01935	0.01986
p-value			0.08407	0.17980
Unemployment Rate			-0.02180	-0.07226
standard error			0.09820	0.10350
p-value			0.82480	0.48660
Percentage of Households with At Least One Vehicle				-0.15990
standard error				0.09510
p-value				0.09590
Percentage of Population between Ages 15–24				-0.04168
standard error				0.05878
p-value				0.48000
Constant	-0.24900	-0.26550	-3.83670	13.35700
standard error	0.55720	0.54660	2.21510	10.24500
p-value	0.65590	0.62820	0.08638	0.19540
Observations	105	105	105	105
Adjusted R-Squared	0.568	0.585	0.591	0.596

Source: Master CAD Report – To Be Produced.csv; American Community Survey Five Year Estimates; US Census Bureau

Note:

[1] The dependent variable is the total number of CAD Roadblocks per 1,000 people per year by census tract.

[2] The Census Bureau has yet to release the 2013–2017 American Community Survey Five Year Estimates. Data from the 2012–2016 American Community Survey Five Year Estimates are used for observations in both 2016 and 2017.

[3] Specification (1) uses number of DUI arrests per 1,000 people per year by census tract for the previous year as a control variable.

[4] Specification (2) uses number of traffic citations and arrests per 1,000 people per year by census tract for the previous year as a control variable in addition to control variables used in specification (1).

[5] Specification (3) uses median household income and the unemployment rate by census tract as control variables in addition to control variables used in specification (2).

[6] Specification (4) uses the percentage of the population between 15–24 and vehicle ownership by census tract as control variables in addition to control variables used in specification (3).

Exhibit 3

Roadblock model using non-normalized counts of roadblocks, DUIs and traffic citations^[1]

Variable ^[2]	(1) With DUI Arrests and Log of Population ^[3]	(2) With Traffic Citations/Arrests ^[4]	(3) With Unemployment and Income ^[5]	(4) With Age and Vehicle Ownership ^[6]
Black Percentage of Population	0.12500	0.14130	0.23760	0.20860
standard error	0.03136	0.03031	0.05844	0.05903
p-value	0.00011	0.00001	0.00009	0.00059
Number of DUI Arrests	1.05360	1.45830	1.45080	1.35030
standard error	0.08596	0.14020	0.14290	0.14670
p-value	0.00000	0.00000	0.00000	0.00000
Number of Traffic Citations/Arrests		-0.10930	-0.10480	-0.10150
standard error		0.03069	0.03092	0.03044
p-value		0.00053	0.00095	0.00114
Median Household Income (in Thousands)			0.09240	0.06359
standard error			0.05289	0.05349
p-value			0.08322	0.23690
Unemployment Rate			-0.04921	-0.22140
standard error			0.25170	0.26070
p-value			0.84540	0.39750
Percentage of Households with At Least One Vehicle				-0.51320
standard error				0.23710
p-value				0.03250
Percentage of Population between Ages 15–24				-0.23700
standard error				0.16090
p-value				0.14340
Log of Total Population	1.84730	3.34150	2.77860	4.31560
standard error	1.53030	1.52100	1.54280	1.65470
p-value	0.22970	0.02993	0.07423	0.01029
Constant	-15.91100	-28.84600	-33.90100	10.15800
standard error	12.65800	12.62700	13.42000	23.54000
p-value	0.21120	0.02409	0.01284	0.66690
Observations	126	126	126	126
Adjusted R-Squared	0.669	0.698	0.702	0.712

Source: Master CAD Report – To Be Produced.csv; American Community Survey Five Year Estimates; US Census Bureau

Note:

[1] The dependent variable is the total number of CAD Roadblocks per year by census tract.

[2] The Census Bureau has yet to release the 2013–2017 American Community Survey Five Year Estimates. Data from the 2012–2016 American Community Survey Five Year Estimates are used for observations in both 2016 and 2017.

[3] Specification (1) uses number of DUI arrests and log of total population per year by census tract as control variables.

[4] Specification (2) uses number of traffic citations and arrests per year by census tract as a control variable in addition to control variables used in specification (1).

[5] Specification (3) uses median household income and the unemployment rate by census tract as control variables in addition to control variables used in specification (2).

[6] Specification (4) uses the percentage of the population between 15–24 and vehicle ownership by census tract as control variables in addition to control variables used in specification (3).

Exhibit 4

Poisson roadblock model, using non-normalized counts of roadblocks, DUIs and traffic citations^[1]

Variable ^[2]	(1) With DUI Arrests and Log of Population ^[3]	(2) With Traffic Citations/Arrests ^[4]	(3) With Unemployment and Income ^[5]	(4) With Age and Vehicle Ownership ^[6]
Black Percentage of Population	0.01272	0.01309	0.02010	0.01581
standard error	0.00274	0.00261	0.00561	0.00542
p-value	0.00000	0.00000	0.00034	0.00352
Number of DUI Arrests	0.05086	0.08273	0.08056	0.07171
standard error	0.00697	0.00973	0.01055	0.01005
p-value	0.00000	0.00000	0.00000	0.00000
Number of Traffic Citations/Arrests		-0.00817	-0.00771	-0.00722
standard error		0.00197	0.00209	0.00193
p-value		0.00003	0.00022	0.00018
Median Household Income (in Thousands)			0.00586	0.00268
standard error			0.00571	0.00541
p-value			0.30530	0.62020
Unemployment Rate			-0.01410	-0.04090
standard error			0.02725	0.02619
p-value			0.60490	0.11830
Percentage of Households with At Least One Vehicle				-0.06221
standard error				0.02127
p-value				0.00344
Percentage of Population between Ages 15–24				-0.03348
standard error				0.01708
p-value				0.05001
Log of Total Population	0.02614	0.30330	0.27440	0.44890
standard error	0.15750	0.15580	0.15360	0.14890
p-value	0.86820	0.05154	0.07407	0.00257
Constant	1.12380	-1.24750	-1.58360	3.90030
standard error	1.33680	1.34340	1.46870	2.37750
p-value	0.40050	0.35310	0.28090	0.10090
Observations	126	126	126	126

Source: Master CAD Report – To Be Produced.csv; American Community Survey Five Year Estimates; US Census Bureau

Note:

[1] The dependent variable is the total number of CAD Roadblocks per year by census tract. The above results are based on a Poisson regression.

[2] The Census Bureau has yet to release the 2013–2017 American Community Survey Five Year Estimates. Data from the 2012–2016 American Community Survey Five Year Estimates are used for observations in both 2016 and 2017.

[3] Specification (1) uses number of DUI arrests and log of total population per year by census tract as control variables.

[4] Specification (2) uses number of traffic citations and arrests per year by census tract as a control variable in addition to control variables used in specification (1).

[5] Specification (3) uses median household income and the unemployment rate by census tract as control variables in addition to control variables used in specification (2).

[6] Specification (4) uses the percentage of the population between 15–24 and vehicle ownership by census tract as control variables in addition to control variables used in specification (3).

Exhibit 5

Roadblock model excluding any roadblocks, DUIs, and traffic citations within 20 meters of a census tract border^[1]

Variable ^[2]	(1) With DUI Arrests ^[3]	(2) With Traffic Citations/Arrests ^[4]	(3) With Unemployment and Income ^[5]	(4) With Age and Vehicle Ownership ^[6]
Black Percentage of Population	0.02946	0.03327	0.04749	0.05001
standard error	0.00713	0.00701	0.01270	0.01272
p-value	0.00007	0.00001	0.00028	0.00014
Number of DUI Arrests Per 1,000 People	1.04770	1.43590	1.34110	1.31990
standard error	0.13480	0.18210	0.19000	0.18910
p-value	0.00000	0.00000	0.00000	0.00000
Number of Traffic Citations/Arrests Per 1,000 People		-0.11380	-0.08541	-0.08288
standard error		0.03726	0.04075	0.04101
p-value		0.00276	0.03822	0.04552
Median Household Income (in Thousands)			0.00630	0.00330
standard error			0.01108	0.01112
p-value			0.57090	0.76730
Unemployment Rate			-0.07664	-0.06305
standard error			0.05551	0.05586
p-value			0.16990	0.26130
Percentage of Households with At Least One Vehicle				0.03786
standard error				0.04773
p-value				0.42920
Percentage of Population between Ages 15–24				-0.06793
standard error				0.03449
p-value				0.05123
Constant	-0.58100	-0.61020	-1.13470	-3.79440
standard error	0.30150	0.29190	1.24520	5.06250
p-value	0.05630	0.03868	0.36400	0.45500
Observations	126	126	126	126
Adjusted R-Squared	0.522	0.552	0.556	0.567

Source: Master CAD Report – To Be Produced.csv; American Community Survey Five Year Estimates; US Census Bureau

Note: [1] The dependent variable is the total number of CAD Roadblocks per 1,000 people per year by census tract, excluding any observations within 20 meters of a census boundary.

[2] The Census Bureau has yet to release the 2013–2017 American Community Survey Five Year Estimates. Data from the 2012–2016 American Community Survey Five Year Estimates are used for observations in both 2016 and 2017.

[3] Specification (1) uses number of DUI arrests per 1,000 people per year by census tract as a control variable, excluding any observations within 20 meters of a census boundary.

[4] Specification (2) uses number of traffic citations and arrests per 1,000 people per year by census tract as a control variable, excluding any observations within 20 meters of a census boundary, in addition to control variables used in specification (1).

[5] Specification (3) uses median household income and the unemployment rate by census tract as control variables in addition to control variables used in specification (2).

[6] Specification (4) uses the percentage of the population between 15–24 and vehicle ownership by census tract as control variables in addition to control variables used in specification (3).

Exhibit 6

Roadblock models with manual census tract assignment (assignment to least black census tracts)

[1]

Variable ^[2]	(1) With DUI Arrests ^[3]	(2) With Traffic Citations/Arrests ^[4]	(3) With Unemployment and Income ^[5]	(4) With Age and Vehicle Ownership ^[6]
Black Percentage of Population	0.02232	0.03162	0.06865	0.06738
standard error	0.00945	0.01057	0.01859	0.01905
p-value	0.01974	0.00337	0.00034	0.00058
Number of DUI Arrests Per 1,000 People	1.42130	1.49630	1.46860	1.45470
standard error	0.09755	0.10440	0.10440	0.11350
p-value	0.00000	0.00000	0.00000	0.00000
Number of Traffic Citations/Arrests Per 1,000 People		-0.08350	-0.05404	-0.06575
standard error		0.04425	0.04631	0.04779
p-value		0.06151	0.24550	0.17150
Median Household Income (in Thousands)			0.03021	0.02622
standard error			0.01676	0.01712
p-value			0.07397	0.12830
Unemployment Rate			-0.08549	-0.08617
standard error			0.08205	0.08520
p-value			0.29960	0.31390
Percentage of Households with At Least One Vehicle				-0.02922
standard error				0.07918
p-value				0.71280
Percentage of Population between Ages 15–24				-0.06568
standard error				0.05274
p-value				0.21550
Constant	-0.61130	-0.73740	-3.74670	0.31330
standard error	0.48960	0.48920	1.90350	8.45160
p-value	0.21420	0.13430	0.05133	0.97050
Observations	126	126	126	126
Adjusted R-Squared	0.641	0.648	0.660	0.659

Source:

Master CAD Report - To Be Produced.csv; American Community Survey Five Year Estimates, U.S. Census Bureau; Hand Coded CAD Roadblocks and DUIs.xlsx; Duplicate Clean Address by Date.xlsx

Note:

[1] The dependent variable is the hand-coded total number of CAD Roadblocks per 1,000 people per year by census tract.

[2] The Census Bureau has yet to release the 2013–2017 American Community Survey Five Year Estimates. Data from the 2012–2016 American Community Survey Five Year Estimates are used for observations in both 2016 and 2017.

[3] Specification (1) uses the hand-coded number of DUI arrests per 1,000 people per year by census tract as a control variable.

[4] Specification (2) uses number of traffic citations and arrests per 1,000 people per year by census tract, excluding any arrests or citations within 20 meters of a census boundary, as a control variable in addition to control variables used in specification (1).

[5] Specification (3) uses median household income and the unemployment rate by census tract as control variables in addition to control variables used in specification (2).

[6] Specification (4) uses the percentage of the population between 15–24 and vehicle ownership by census tract as control variables in addition to control variables used in specification (3).

EXHIBIT 3

**UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
JACKSON DIVISION**

LATOYA BROWN; LAWRENCE
BLACKMON; HERBERT ANTHONY
GREEN; KHADAFY MANNING;
QUINNETTA MANNING; MARVIN
MCFIELD; NICHOLAS SINGLETON;
STEVEN SMITH; BESSIE THOMAS; and
BETTY JEAN WILLIAMS TUCKER,
individually and on behalf of a class of all
others similarly situated,

Plaintiffs,

v.

MADISON COUNTY, MISSISSIPPI;
SHERIFF RANDALL S. TUCKER, in his
official capacity; and MADISON COUNTY
SHERIFF'S DEPUTIES JOHN DOES #1
through #6, in their individual capacities,

Defendants.

Civil Action No.

3:17-cv-00347-WHB-LRA

REBUTTAL EXPERT REPORT OF PATRICIA FRONTIERA, Ph.D.

July 2, 2018

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1. QUALIFICATIONS AND ASSIGNMENT

1.1. *Qualifications*

1. I am a geospatial data scientist with the Social Sciences Data Lab (D-Lab) at the University of California Berkeley. The D-Lab provides research support to graduate students, advanced undergraduates, faculty and other scholars on methods and tools for computational data analysis. In my position at the D-Lab I lead our geospatial topic area which entails developing and teaching workshops on a wide variety of topics related to geospatial data, mapping and spatial analysis as well as consulting with individuals and on research projects in this domain. I have been with the D-Lab since August 2014.
2. Geocoding is one of my areas of expertise at the D-Lab. Since 2015 I have developed and taught over 12 workshops on geocoding using the ArcGIS, the Google Maps API, the Census Geocoding API as well as methods for geocoding in the R and Python programming languages. I regularly consult with researchers on geocoding strategies and tools, averaging one such consult per month, many of which extend over multiple visits.
3. In addition to my position at the D-Lab I have taught courses on geospatial data analysis as a lecturer University of California Berkeley for the departments of Landscape Architecture & Environmental Planning, Environmental Science, and Policy Management and the newly formed Division of Data Science. As a lecturer for the Division of Data Science I created one of the first, if not the first, undergraduate introduction to geographic data course using the Python programming language in the U.S.
4. My professional and academic work has involved geographic data and ESRI products such as ArcGIS since 1996 when I joined the staff of the UC Berkeley Center for Environmental Design research as a research programmer. I earned my Ph.D. in Environmental planning from UC Berkeley where my thesis explored the use of generalized coordinate representations in geographic information retrieval.
5. After my Ph.D. and prior to joining the D-Lab, I was a senior GIS technology specialist for the San Francisco Estuary Institute, a non-profit focused on improving the health and resiliency of aquatic habitats in the Bay Area. In this position I

created several web-based mapping tools that incorporated geocoding functionality to map locations by place names and addresses.

6. My CV is attached as Appendix A to this report and includes a detailed list of my professional and academic work including conference presentations and publications.
7. I have never testified as an expert. I am providing my services in this matter at a rate of \$250/hour.

1.2. Assignment

8. I have been asked by counsel for Plaintiffs to review the reports of Mr. Funderburk and Dr. Ricchetti, and comment on Mr. Funderburk's opinions about the location data produced in this case by the Madison County Sheriff's Department and the geocoding done by Dr. Ricchetti.

1.3. Summary of Findings

9. I have reviewed the reports of Dr. Ricchetti and Mr. Funderburk. In this report, I evaluate the geocoding performed in Dr. Ricchetti's initial report, and respond to several of the claims by Mr. Funderburk about this geocoding and its use in Dr. Ricchetti's analysis. I find that Dr. Ricchetti's initial report followed best practices resulting in a high level of overall geocoding quality. Specifically, Dr. Ricchetti geocoded locations with ArcGIS, a widely used geocoding software package, using standard and accepted techniques.
10. I further find that Mr. Funderburk frequently overstates many of his claims. He concludes that Dr. Ricchetti's geocoding is not accurate, precise, or reliable but does not support these conclusions with standard geocoding evaluation practices or statistical analysis. Mr. Funderburk's misstatements appear to stem from (1) a failure to consider the ultimate purpose of Dr. Ricchetti's geocoding, (2) a failure to meet the academic standard of a randomized evaluation, and (3) a lack of familiarity with the academic literature surrounding geocoding best practices.
11. Contrary to what Mr. Funderburk implies in his report, neither a geographer nor a geospatial professional is needed to successfully geocode roadblock locations with ArcGIS. ArcGIS and other software for working with geographic information are used in a wide variety of professions and academic disciplines. On a regular basis, I

teach and consult with epidemiologists, planners, economists, historians, sociologists, political scientists, humanists, linguists, computer scientists, and legal scholars, among others, who successfully use ArcGIS and geocoding in their work without being experts in either. Because of this, I do not agree with Mr. Funderburk's contention that Dr. Ricchetti needed to retain an expert geographer or geospatial professional in order to obtain reliable and accurate geocoded locations from ArcGIS.

12. Mr. Funderburk's claims that street intersections cannot be accurately geocoded are contrary to my own experience and to the numerous academic studies in which these data are accurately geocoded and the resulting locations used in analyses. In particular, this practice is widely used in transportation research and public health research that investigates vehicle and pedestrian accidents.
13. Contrary to Mr. Funderburk's claims, a geocoding match score is a standard metric for evaluating the quality of geocoded locations. Higher thresholds for match scores are associated with an overall higher level of geocoding accuracy and precision. Dr. Ricchetti's analysis used a conservatively high threshold of 90 relative to thresholds used in academic papers.
14. The research literature is clear that geocoding accuracy must be evaluated relative to the application in which it is being applied. Dr. Ricchetti's analysis uses the geocoded output to identify census tracts in which roadblocks are located. Mr. Funderburk's claim that the positional accuracy of Dr. Ricchetti's geocoding is insufficient to identify the census tract in which a roadblock was located is not supported by my review of the data or published academic work.
15. Mr. Funderburk identifies purported flaws in Dr. Ricchetti's analysis that are not in fact flaws and fails to demonstrate how these purported flaws are material to Dr. Ricchetti's analysis. Specifically, most of the purported flaws in geocoding Mr. Funderburk identifies are in fact ostensible errors in the underlying data, not errors in geocoding. Mr. Funderburk also expounds on the need for coordinate reference system alignment but does no analysis to show how this impacts the overall results of Dr. Ricchetti's analysis. I discuss below why this is not an issue in the analysis.
16. Mr. Funderburk claims that roadblocks located in streets that are also census tract boundaries invalidate Dr. Ricchetti's analysis, yet again he offers no analysis to support this. Rather, I confirm the accuracy of Dr. Ricchetti's census tract

boundaries and perform analysis to show that the method Dr. Ricchetti uses to associate roadblocks with census tracts was reliable, and that any incremental error in the assignment of roadblocks on census tract boundaries to specific tracts likely resulted in undercounting number of roadblocks within census tracts with a relatively high black population percentage. Thus, this purported issue in fact makes Dr. Ricchetti's results likely conservative.

2. ARCGIS IS A WIDELY USED TOOL IN ACADEMIC RESEARCH

17. ESRI's ArcGIS is a widely used tool for geocoding data for statistical analysis. Research articles that compare geocoding tools almost always include a review of ArcGIS, or its predecessor ArcView, indicating its prominent use.¹ There are few commercial alternatives that offer the same level of ease of use, input customization, both on-premise and online environments, and high output quality. The Google Geocoding API produces comparable output quality but with the tradeoff that a programming interface is required (no graphical user interface).²
18. Geocoding with ArcGIS is widely used because it is very highly regarded. ESRI is one of the oldest GIS software companies and its business is focused on creating software tools for geographical data, analysis, and mapping. This focus has allowed ESRI many years to progressively refine and improve their products, efforts from which I have benefited greatly over the last 18+ years as these tools evolved from ArcView 3.1 to 10.5.1. In short, ESRI's ArcGIS suite of tools and related data products are the de facto standard for geocoding in academic teaching and research, commanding a dominant share of the commercial market as well.³
19. There is an extensive body of literature on the successful application and evaluation of geocoding by leading scholars in a variety of fields including public health, epidemiology, city and regional planning, transportation, public safety, economics, and sociology, among others. For example, the multi-year Harvard Public Health Disparities Geocoding Project produced a number of articles that demonstrate the effectiveness of geocoding health data and associating it with census tract-level demographic data in order to better understand and improve socio-economic disparities in access to healthcare.⁴ The journal *Spatial and Spatio-temporal*

¹ For example, see Zandbergen, Paul A., "Geocoding Quality and Implications for Spatial Analysis," *Geography Compass*, 3(2), 2009, pp. 647–680.

² Roongpiboonsopit, Duangduen and Hassan A. Karimi, "Comparative Evaluation and Analysis of Online Geocoding Services," *International Journal of Geographical Information Science*, 24(7), 2010, pp. 1081–1100.

³ Duncan, Dustin T., et al., "Evaluation of the Positional Differences Between Two Common Geocoding Methods," *Geospatial Health*, 5(2), 2011, p. 266.

⁴ "The Public Health Disparities Geocoding Project Monograph: Executive Summary," available at Harvard T.H. Chan School of Health, <https://www.hsph.harvard.edu/thegeocodingproject/executive-summary>; Krieger, Nancy et al., "Geocoding and Monitoring of US Socioeconomic Inequalities in Mortality and Cancer Incidence: Does the Choice of Area-based Measure and Geographic Level Matter?," *American Journal of Epidemiology*, 156(5), 2002, pp. 471–482.; Krieger, Nancy, "A Century of Census Tracts: Health & the Body Politic (1906–2006)," *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 83(3), 2006, pp. 355–361.

Epidemiology dedicated a special issue to the topic of geocoding and health research.⁵ Additionally, Ratcliffe evaluates the effectiveness of geocoding for crime mapping.⁶ More germane to this report, Levine & Kim, Dutta et al., Bigham et al., Park, and Qin all describe effective methods for geocoding intersections where motor vehicle crashes occur.⁷

20. As I describe below, most of the geocoding critiques of Dr. Ricchetti's analysis identified by Mr. Funderburk stem from incomplete information in the data provided by MCSD rather than from geocoding errors. As I discuss below, this case also presents the issue of the existence of roadblocks on boundaries of census tracts. This is, however, not a geocoding problem and rather a geographical problem that can be assessed through a variety of robustness analyses.
21. Geocoding is the process of determining the geographic coordinates for a named place, street address, postal code, or any other non-geometric representation of a geographic location. I will limit this discussion to street address and intersection geocoding. The process is straight-forward and consistent across geocoding software. First, you undertake several steps to "clean" or standardize the data you want to geocode. This entails (1) putting your records in the file format required by your geocoding software, with either all address components in the same column or in separate columns, e.g. *street name, city, state, zip*; (2) standardizing the text format of your records, e.g. with consistent capitalization, abbreviations for streets (Ave for Avenue), and conventions such as "&" or "AND" to denote an intersection; and (3) adding as much information as possible to all records such as the city, county, state, and zip code.
22. A review of the data provided by Dr. Ricchetti to Mr. Funderburk in the table of *Compiled Unique Roadblocks* shows how this was done for these roadblock data.⁸ I

⁵ *Spatial and Spatio-temporal Epidemiology*, 3(2), 2012, pp. 93–112.

⁶ Ratcliffe, Jerry H., "Geocoding Crime and a First Estimate of a Minimum Acceptable Hit Rate," *International Journal of Geographical Information Science*, 18(1), pp. 61–72.

⁷ Levine, Ned and Karl E. Kim, "The Location of Motor Vehicle Crashes in Honolulu: A Methodology for Geocoding Intersections," *Computational, Environmental and Urban Systems*, 22(6), 1998, pp. 557–576; Dutta, Arup, et al., "System for Digitizing Information on Wisconsin's Crash Locations," *Journal of the Transportation Research Board*, (19), 2007, pp. 256–264; Qin, Xiao, et al., "Intelligent Geocoding System to Locate Traffic Crashes," *Accident Analysis and Prevention*, 50, 2013, pp. 1034–1041; Bigham, John M., et al., "Geocoding Police Collision Report Data from California: A Comprehensive Approach," *International Journal of Health Geographics*, 8(72), 2009, pp. 1–10; Park, Shin H., et al., "Geocoding Vehicle Collisions on Korean Expressways Based on Postmile Referencing," *Journal of Civil Engineering*, 15(8), 2011, pp. 1435–1441.

⁸ Report of William R. Funderburk, May, 8, 2018 ("Funderburk Report"), Appendix D.

- include this table in my report as Appendix C. If you compare the values in the *original_address* column with those in the *clean_address* column you see that the street names have been formatted in upper case, with “AND” as the intersection delimiter, the county and state has been added to each address, and address components are comma delimited. Contrary to what Mr. Funderburk states, the applied cleaning process is transparent and consistent with standard practices.
23. Once the input data are “clean” they can be geocoded. Geocoding requires three key components. The first is the input data. The second is a reference database against which input locations will be compared for candidate matches. The third is the geocoding software engine that ingests the input data and uses algorithms and rules to search the reference database for matches.
 24. The quality of the reference database is directly related to the output quality.⁹ A reference database that is comprehensive in geographic coverage, is up-to-date, and contains a high level of spatial and attribute detail and accuracy will provide better results. Moreover, geocoding reference databases are increasingly adding multiple spatial representations against which input data can be matched including parcel polygons and center points, street centerlines, street intersection tables, and named points of interest.¹⁰
 25. Available ArcGIS reference databases include the online World Geocoding Service, the ArcGIS Business Analyst Geocoding data, and Streetmap Premium data for ArcGIS. The latter two databases are updated annually while the online World Geocoding Service is updated more frequently. In my professional opinion the World Geocoding Service reference database is one of the best available for locations in the United States, along with the Google Geocoding API reference database.
 26. ArcGIS provides a number of software tools that can geocode input data with the World Geocoding Service reference database. One approach is to use the ArcGIS Desktop software, locally installed on your computer, which provides a graphical

⁹ Goldberg, Daniel W., John P. Wilson and Craig A. Knoblock, “From Text to Geographic Coordinates: The Current State of Geocoding,” *Journal of the Urban and Regional Information Systems Association*, 19(1), 2007, pp. 33–46; Zandbergen, Paul A., “Geocoding Quality and Implications for Spatial Analysis,” *Geography Compass*, 3(2), 2009, pp. 647–680.

¹⁰ Zandbergen, Paul A., “A Comparison of Address Point, Parcel and Street Geocoding Techniques,” *Computers, Environment and Urban Systems*, 32(3), 2008, p. 218.

user interface to make requests to the remote service. Another approach is to write a script, or short software program, that uses an API (or application programming interface) to submit your records to be geocoded to the online ArcGIS World Geocoding Service. My review of Dr. Ricchetti's Python geocoding script shows that this latter method was used to geocode the roadblock locations with the ArcGIS World Geocoding Service.

27. In short, contrary to what Mr. Funderburk has suggested, Dr. Ricchetti used standard practices to geocode roadblock locations using one of the best, if not the best, available geocoding tools — the ArcGIS World Geocoding Service.

3. STREET INTERSECTIONS CAN BE RELIABLY GEOCODED

28. Mr. Funderburk identifies several potential areas of geocoding imprecisions in Dr. Ricchetti's analysis. Mr. Funderburk concludes that "it does not appear that the address information kept by MCSD contains enough information to perform geographic analysis such as geocoding."¹¹ Based on my professional experience, the types of imprecision Mr. Funderburk identifies are common in administrative data and do not render geocoding and statistical analysis of the data unreliable.

3.1. *Street intersection data contain enough location information to be successfully geocoded*

29. Mr. Funderburk suggests repeatedly that street intersections cannot be accurately geocoded and that this is a significant problem for Dr. Ricchetti, because 93.4% of the roadblock locations in this case are recorded at intersections rather than at exact addresses.¹² He states:¹³

"To geocode properly, the software needs to compute the geometry of the desired point information. If we are using hard street addresses and have performed our pre-processing calibration, it is a relatively easy process. However, using intersection-only information introduces a variety of errors in geospatial accuracy and precision."

30. I strongly disagree with these assertions. As I explain above, street intersections can be and are regularly geocoded with acceptable levels of accuracy and precision.¹⁴ Street intersection geocoding has some of the same challenges as street address geocoding such as the need for high quality geocoding software and a high quality reference database, both of which are provided by ArcGIS. Both require sufficient input information to determine a location. For a street address this includes a street number, street name, and containing locality (e.g., city, zip code, county, state, country) while a street intersection needs only the names of the two streets and the

¹¹ Funderburk Report, ¶ 46.

¹² Funderburk Report, ¶ 45.

¹³ Funderburk Report, ¶ 49.

¹⁴ Levine, Ned and Karl E. Kim, "The Location of Motor Vehicle Crashes in Honolulu: A Methodology for Geocoding Intersections," *Computational, Environmental and Urban Systems*, 22(6), 1998, pp. 557–576; Dutta, Arup, et al., "System for Digitizing Information on Wisconsin's Crash Locations," *Journal of the Transportation Research Board*, (19), 2007, pp. 256–264; Qin, Xiao, et al., "Intelligent Geocoding System to Locate Traffic Crashes," *Accident Analysis and Prevention*, 50, 2013, pp. 1034–1041; Bigham, John M., et al., "Geocoding Police Collision Report Data from California: A Comprehensive Approach," *International Journal of Health Geographics*, 8(72), 2009, pp. 1–10; Park, Shin H., et al., "Geocoding Vehicle Collisions on Korean Expressways Based on Postmile Referencing," *Journal of Civil Engineering*, 15(8), 2011, pp. 1435–1441.

locality. One challenge unique to street intersection geocoding is that two streets can intersect in more than one location within the same locality, for example where a divided road intersects with another street. These cases can be easily identified, reviewed, and, if needed, resolved with the ArcGIS geocoder which will return a match type of *street intersection* with a status of *tied* for these locations.

31. Based on my experience I would argue that street intersections can be geocoded with a higher level of positional accuracy than street addresses, particularly when street address geocoding is based on interpolation, a common practice to compute coordinates for a street address based on the relative position of a street number with a street address range. For example, 50 Main St would be interpolated to the middle of a block with addresses ranging from 0 to 100. However, numerous studies have shown that linear interpolation can be quite inaccurate in areas with curved streets, cul-de-sacs, and irregularly shaped or sized parcels.¹⁵

3.2. Dr. Ricchetti's use of the Match Score is consistent with Standard Geocoding Practice

32. In his report Mr. Funderburk asserts that Dr. Ricchetti did not adequately assess the quality of the geocoding output.¹⁶ He also criticizes Dr. Ricchetti's use of the match score as a measure of geocoding quality and accuracy.¹⁷ I comment on both of these below.
33. Geocoding quality is most commonly evaluated in terms of match rate and positional accuracy.¹⁸ Match rate refers to the percent of total input records for which the geocoder found a successful match. ArcGIS, and other geocoding software, will return a match status of matched, tied, or unmatched for each location input to the geocoder to indicate whether or not the software was able to find a match in the reference database.

¹⁵ For example, see Goldberg, Daniel W., John P. Wilson, and Craig A. Knoblock, "From Text to Geographic Coordinates: The Current State of Geocoding," *Journal of the Urban and Regional Information Systems Association*, 19(1), 2007, pp. 33–46.

¹⁶ Funderburk Report, ¶¶ 17, 32, 60.

¹⁷ Funderburk Report, ¶¶ 67–69

¹⁸ Abe, Toshi, and David Stinchcomb, "Geocoding Practices in Cancer Registries," Gerard Rushton et al., (Eds.), *Geocoding Health Data: The Use of Geographic Codes in Cancer Prevention and Control, Research and Practice*, CRC Press, Boca Raton, Florida, 2008, pp. 111–125; Zandbergen, Paul A., "Geocoding Quality and Implications for Spatial Analysis," *Geography Compass*, 3(2), 2009, p. 652.

34. A match score threshold is then commonly used as an indicator of a successful match. According to the documentation for the ArcGIS World Geocoding Service the match score is:¹⁹

“A number from 1–100 indicating the degree to which the input tokens in a geocoding request match the address components in a candidate record. A score of 100 represents a perfect match, while lower scores represent decreasing match accuracy. Score is always returned by default.”

35. The match score is a measure of a degree to which an input address was matched to data in the reference database. The higher the score the greater the degree to which the values match.
36. Schootman states in a journal article specifically evaluating geocoding quality that addresses “with a match score of 75 or more were considered a good match.”²⁰ Yang discusses setting a minimum match score to 80 to improve geocoding results.²¹ Dr. Ricchetti conservatively requires a match score of at least 90.²²
37. Positional accuracy refers to the distance between the geocoded location and the real location.²³ For example, if the geocoded point represents a street address then the shortest distance between the point and the boundary of the property would be the positional accuracy.
38. The level of positional accuracy deemed acceptable varies depending on the specific application.²⁴ For example, in a study of vehicle collisions, Bigham defines

¹⁹ “Service Output,” available at *ArcGIS for Developers*, <https://developers.arcgis.com/rest/geocode/api-reference/geocoding-service-output.htm>.

²⁰ Schootman, Mario, et al., “Positional Accuracy and Geographic Bias of Four Methods of Geocoding in Epidemiologic Research,” *Annals of Epidemiology*, 17(6), 2007, pp. 464–470.

²¹ Yang, Duck-Hye, et al., “Improving Geocoding Practices: Evaluation of Geocoding Tools,” *Journal of Medical Systems*, 28(4), 2004, pp. 361–370.

²² Deposition of Bryan Ricchetti, Ph.D., April 6, 2018 (“Ricchetti Deposition”), p. 168:4–10.

²³ Zandbergen, Paul A., “Geocoding Quality and Implications for Spatial Analysis,” *Geography Compass*, 3(2), 2009, p. 652.

²⁴ Zandbergen, Paul A., “Geocoding Quality and Implications for Spatial Analysis,” *Geography Compass*, 3(2), 2009, pp. 663–666.

- positionally accurate geocoding as any geocoded point within 50 feet of the real world location as depicted on Google Earth Pro imagery.²⁵
39. The match score is also used as an indicator of positional accuracy.²⁶ Duncan reports that only “geocoded addresses with the highest positional accuracy (as defined by a match score of ≥ 80)” were included in his study.²⁷ According to Zandbergen, “lowering the minimum match score results in a decrease in accuracy and therefore geocoding quality,” which implies that the inverse is true – raising the minimum match score improves geocoding accuracy and quality.²⁸
 40. Other measures of geocoding quality include reliability and precision. Reliability is primarily a qualitative measure of the degree of confidence in the geocoding results based on the reputability of the software vendor and the geocoding reference database.²⁹ As discussed previously, ArcGIS geocoding software and reference databases are highly regarded and widely used.
 41. Geocoding precision is a measure of the variance in positional accuracy. While positional accuracy is quantified as the measured distance between geocoded points and real locations, precision refers to the difference between those distances and the average distance for the data set as a whole. If match score is used as an indicator of positional accuracy, then variation in match scores can be used to evaluate precision. Moreover, to the extent that a high minimum match score increases geocoding accuracy it would also likely increase precision.
 42. In short, contrary to Mr. Funderburk’s claims, Dr. Ricchetti did evaluate the overall quality of the geocoding output. His evaluation was based on the geocoding match

²⁵ Bigham, John M., et al., “Geocoding Police Collision Report Data from California: A Comprehensive Approach,” *International Journal of Health Geographics*, 8(72), 2009, pp. 1–10.

²⁶ Goldberg, Daniel W., “A Geocoding Best Practices Guide,” *The North American Association of Central Cancer Registries*, 2008, p. 98.

²⁷ Duncan, Dustin T., et al., “Evaluation of the Positional Difference Between Two Common Geocoding Methods,” *Geospatial Health*, 5(2), 2011, p. 272.

²⁸ Zandbergen, Paul A., “A Comparison of Address Point, Parcel and Street Geocoding Techniques,” *Computers, Environment and Urban Systems*, 32(3), 2008, p. 218.

²⁹ Goldberg, Daniel W., “A Geocoding Best Practices Guide,” *The North American Association of Central Cancer Registries*, 2008, p. 98.

rate and match score, both of which are standard metrics of overall geocoding. The use of the match score in Dr. Ricchetti's report is consistent with standard practice.

3.3. Mr. Funderburk's Assessment of Geopositional Accuracy is Flawed

43. In contrast, in his report Mr. Funderburk does not use standard geocoding practices to evaluate the geocoding results used in Dr. Ricchetti's study. Note, Mr. Funderburk uses the term "geopositional accuracy" in his report whereas I use the term "positional accuracy" to be consistent with the geocoding literature.
44. In his report, Mr. Funderburk argues that the use of a high match score is not an indicator of geocoding quality.³⁰ He supports this claim by overlaying 25,335 geocoded points from Dr. Ricchetti's analysis with a match score greater than or equal to 90 onto a map of the continental United States.³¹ Because this map displays geocoded points that are located outside of Madison County, Mr. Funderburk concludes that Dr. Ricchetti's geocoding shows extreme errors and is evidence of improper geocoding.³² However, Mr. Funderburk does not quantify those errors in order to substantiate his conclusion.
45. In my analysis of those points, only 204 of 25,335 points, or 0.8%, were located outside of Madison County. In my professional opinion, that percentage is an indicator of a very high level of geocoding quality, consistent with Dr. Ricchetti's use of the match score.
46. Separately from his critique of data points with a match score above 90, Mr. Funderburk presents an "incomplete" (by his own admission)³³ and statistically biased assessment of the positional accuracy of the geocoded roadblock locations in Dr. Ricchetti's report. From this, he concludes without foundation that there are "countless erroneously geocoded locations."³⁴ His assessment is based on a review of a small subset of the geocoded locations that he undertook with Deputy Rylon

³⁰ Funderburk Report, ¶¶ 66–70.

³¹ Funderburk Report, Figure 4.

³² Funderburk Report, ¶¶ 69–70.

³³ Funderburk Report, ¶ 48.

³⁴ Funderburk Report, ¶ 16.

Thompson. Mr. Funderburk claims that this review employed a method called “ground truthing.”³⁵

47. First, I will review the method of ground truthing as it is applied to the evaluation of positional accuracy in geocoding. Then I will describe how Mr. Funderburk did not adequately employ this method and therefore cannot assess the overall positional accuracy of Dr. Ricchetti’s geocoding.
48. Ground truthing is a widely used method for evaluating the accuracy and precision of geocoded results.³⁶ In geocoding applications, the method refers to the process of comparing geocoded point locations to the location of the real world features they represent. Coordinates for the real world feature are obtained by (1) physically visiting the site and using a GPS; (2) reviewing the site on high-resolution imagery such as Google Maps or Google Earth satellite imagery; or less typically (3) from a database of known coordinate locations.
49. Ground truthing requires that a statistically random sample of the geocoded points be selected for review.³⁷ Random in the statistical sense means that any observation has the same chance of being selected for review. Random sample sizes discussed in the geocoding literature vary depending on the goals of the analysis at hand and typically range from 1%³⁸ to 5%.³⁹
50. For each selected point the Euclidean distance between the geocoded and real world coordinates is measured. The distance would then be recorded for each pair of points. The overall positional accuracy of the geocoding would then be determined based on the average or median distances between the geocoded points reviewed and the location in the real world.
51. It is important to note that points are simplistic representations of complex, real world geographic features such as a parcel boundaries, structures, street

³⁵ Funderburk Report, ¶¶ 12, 46–48.

³⁶ Goldberg, Daniel W., “A Geocoding Best Practices Guide,” *The North American Association of Central Cancer Registries*, 2008, p. 104.

³⁷ For example, see Zhan, F.B. et al., “Match Rate and Positional Accuracy for Two Geocoding Methods for Epidemiologic Research,” *Annals of Epidemiology*, 16(11), 2006, p. 845.

³⁸ Qin, Xiao, et al., “Intelligent Geocoding System to Locate Traffic Crashes,” *Accident Analysis and Prevention*, 50, 2013, p. 1039.

³⁹ Duncan, Dustin T. et al., “Evaluation of the Positional Difference Between Two Common Geocoding Methods,” *Geospatial Health*, 5(2), 2011, p. 267.

- intersections, and roadblocks, all of which have features such as size, shape, and orientation that cannot be captured by a point. Given this inherent generalization, positional accuracy is evaluated relative to a point location *within* or *near* the real world geographic feature it represents, for example the center point of a parcel street intersection. Therefore, the process of evaluating positional accuracy requires the documentation of this evaluative criteria.
52. Moreover, because a point is a simplistic representation of a real world geographic feature, ground truthing and accuracy assessment require knowledge of the real world feature under study in order to identify its location on a map or in the field. In this case that would be a person with first-hand knowledge of the location of the roadblocks.
 53. The ground truthing analysis as conducted by Mr. Funderburk and Deputy Thomson was flawed for at least two reasons. First, Mr. Funderburk did not review with Deputy Thompson a random sample of the geocoded locations. Second, Mr. Funderburk compared locations geocoded by Dr. Ricchetti to the locations where Deputy Thompson believed the roadblocks physically existed, not to the physical locations on the ground representing the addresses in the *Compiled Unique Roadblocks*. Any discrepancy in Dr. Ricchetti's analyses of this type would be due to imprecise address recording in the *Compiled Unique Roadblocks* by the sheriff's department, not due to geocoding errors. Therefore, whatever the results of his analysis, they cannot be used to draw conclusions about either the positional accuracy or overall quality of the geocoding results.
 54. Moreover, I would argue that there is statistical bias in the points that were selected for review.⁴⁰ I say this because a visual review of a map of the geocoded locations will naturally draw one's eyes to the errors, be they few or many, rather than the correct locations. We saw that to be the case in Mr. Funderburk's use of Figure 4 in his report, which I discussed previously.
 55. Mr. Funderburk did not define and use a consistent evaluative criteria for positional accuracy. He did not state what constituted an accurately located roadblock, e.g. within 10 meters of the center of the intersection in which it was located. Additionally, Mr. Funderburk did not measure the distance between each of the

⁴⁰ Deposition of William R. Funderburk, June 20, 2018 ("Funderburk Deposition"), pp. 42:24–44:14.

reviewed geocoded points and the locations of the roadblocks that they represent and use those distances to compute an overall metric of positional accuracy.

56. Mr. Funderburk's report implies that Deputy Thompson is familiar with the location of the roadblocks under study and thus provides the local knowledge needed to ground truth geocoded locations.⁴¹ However, he did not confirm that Deputy Thompson was in fact present at all of the roadblocks that they reviewed together or take any other steps to verify the accuracy of Deputy Thompson's recollections.⁴² Therefore, I cannot tell if Deputy Thompson indeed had the local knowledge needed to ground truth the roadblock locations.
57. Additionally, it is clear that Deputy Thompson brought to Mr. Funderburk's review process additional knowledge about roadblock locations that was not included in the information provided as the input to the geocoding software for some of the roadblocks. For example, when describing his Exhibit 1, Mr. Funderburk states "Point No. 18 should be 0.21 miles north on Harbor Drive". The location listed for point 18 that was used to geocode is "HARBOR AND LAKE HARBOR, MADISON COUNTY, MS".⁴³ The geocoded point is shown below on a screen shot of Mr. Funderburk's Exhibit 1 as a green circle at that very intersection, indicative of an accurate geocoding result, where I use accurate to mean within the intersection.

⁴¹ Funderburk Report, ¶ 46.

⁴² Funderburk Deposition, p. 39:6–12. ("Q. When you interviewed Deputy Thompson, did he confirm to you that he had been present at each of the roadblocks that had been plotted in Dr. Ricchetti's report? A. He was present at the roadblocks that are in my exhibits. I can't attest to if he was present at every roadblock in Dr. Ricchetti's report.")

⁴³ Funderburk Report, ¶ 48, Appendix D.

EXHIBIT 1

Replication of Funderburk Exhibit 1



Source: Funderburk Report

Note: From Funderburk Exhibit 1. Image depicts the geocoded location of Roadblock Point 18 (green circle) and the roadblock's "actual" location (X)

58. Yet, Mr. Funderburk presents this as an example of an incorrectly geocoded location because Deputy Thompson states that the “real” location of the roadblock was at the intersection of W. Ramp Rd. and Harbor Dr.⁴⁴ If that were to be true then this is not a geocoding error but rather an error in the underlying data produced in this case – i.e., whoever at the sheriff’s department was responsible for reporting or recording the location of the roadblock did so incorrectly or imprecisely. Data

⁴⁴ Funderburk Report, ¶ 48, Exhibit 1.

recording errors are present in most geocoding input data and do not invalidate the use of such databases.

59. I reviewed the point locations discussed by Mr. Funderburk in Exhibits 1–11 of his report.⁴⁵ My evaluation is shown in my Exhibit 2 below. Ten of the 22 points he presents as evidence of geocoding errors or incorrect census tract assignments are of the nature described above – a discrepancy between the location listed in the table and what Deputy Thompson claimed was the true location of the roadblock. Four are data input errors. Three do not include sufficient address information. Four concern the assignment of roadblocks to census tracts, which I discuss in more detail below in Section 3.5. Only one point could be considered a geocoding positional accuracy error.

EXHIBIT 2

Taxonomy of Errors Asserted for the 22 Points Reviewed by Mr. Funderburk and Claimed to Demonstrate Inaccurate Geocoding, From Funderburk Report, Paragraph 48 and Corresponding Exhibits 1-11

Type of Error Asserted	Description	Point Numbers	Number of points
Bad Data Input	Deputy Thompson's location for the roadblock differs from that listed in the table of Compiled Unique Roadblocks	18, 53, 141, 215, 14, 203, 98, 129, 151, 161	10
Bad Data Input	Typos, abbreviations, or incorrect data input	77, 244, 12, 193	4
Insufficient Address Information	Data input lacked a street address or intersection	159, 287, 3	3
Boundary	Census tract boundary assignment discussed	344, 51, 11, 67	4
Low positional accuracy	Geocoded point evaluated as too far from actual location	100	1

⁴⁵ Funderburk Report, ¶ 48, Exhibit 1–11.

60. Mr. Funderburk bases his assessment of positional accuracy on the assumption that Deputy Thompson's assertions regarding the roadblock locations, and not the addresses and street intersections listed for each roadblock in the table of *Compiled Unique Roadblocks*, identifies their true location. Even if Deputy Thompson's recollection is correct that actual roadblock locations differ from the table of *Compiled Unique Roadblocks* for the limited sample of observations he considered, which I cannot assess, these findings would not necessarily be representative of the data set as a whole because the locations were not selected randomly.
61. It is my professional opinion, based on the above discussion, that Mr. Funderburk's ground truthing process was not performed in accordance with geocoding standard practices. His sample was not random, his process was not documented nor consistently applied, and his knowledge of the true location of roadblocks was based on his interview with Deputy Thompson which was not substantiated. Further, the purported geocoding errors he identifies are, in fact, not geocoding errors. They are either data errors or reliably geocoded roadblocks located on or near census tract boundaries (which I discuss in detail in Section 3.5). Thus, his analysis does not support his conclusions that Dr. Ricchetti's geocoding contains "a variety of errors in geopositional accuracy and precision."⁴⁶

3.4. Coordinate Reference System Issues do not significantly impact the analysis of Roadblock locations

62. In section 4.4 of his report, Mr. Funderburk asserts that issues related to coordinate reference systems undermine the quality and validity of Dr. Ricchetti's analysis. I find this to be untrue and discuss my reasoning below.
63. Geographic coordinates expressed as longitude and latitude can be identical and yet reference two different physical real world locations if they are referenced to different datums. There are currently two families of datums in widespread use for geographic locations in the United States. These are the North American Datum of 1983 (NAD83) and the World Geodetic System of 1984 (WGS84). The ArcGIS World Geocoding Service, which was used by Dr. Ricchetti, returns geocoded

⁴⁶ Funderburk Report, ¶ 49.

- results in the WGS84 datum.⁴⁷ Census tract boundary spatial data files, called TIGER Files, are distributed with geographic coordinates referenced to NAD83.
64. For the continental United States, the positional difference in WGS84 and NAD83 coordinates varies from one meter to four meters depending on the version of the datums used. For applications that require less than three meter accuracy, transformations between these two datums are not recommended as those transformations can introduce additional error.⁴⁸ In other words, it is common practice to treat WGS84 and NAD83 geographic coordinates as though they were referenced to the same coordinate reference system.
 65. Dr. Ricchetti's analysis does not require sub-three meter positional accuracy to identify the census tract in which a roadblock represented by a point resides. This is because census tract boundaries do not have sub-three meter positional accuracy. In fact the US Census does not publish the positional accuracy of census tract geographic data.⁴⁹ We can also safely assume that the geocoded roadblocks do not have sub-three meter positional accuracy since the street intersections and street addresses against which they are geocoded are typically more than three meters wide in one dimension.
 66. WGS84 and NAD83 are both three-dimensional geographic coordinate systems. Geographic coordinates are often transformed to a two-dimensional projected coordinate system before any spatial analysis is undertaken. This transformation is required if the spatial analysis includes distance-based measurements or if the study area is global or near the North Pole or South Pole.
 67. Dr. Ricchetti's spatial analysis did not involve distance-based measurements. His analysis only considered the topological spatial relationships between census tract polygons and roadblocks.

⁴⁷ "Service Output," available at *ArcGIS for Developers*, <https://developers.arcgis.com/rest/geocode/api-reference/geocoding-service-output.htm>.

⁴⁸ Fromhertz, Pamela, "Datums and Tools to Connect Geospatial Data Accurately," *National Oceanic and Atmospheric Administration*, June 20, 2012, available at https://www.ngs.noaa.gov/web/science_edu/presentations_library/files/usgs_css_brownbag20june2012final.pdf.

⁴⁹ "Positional Accuracy of TIGER/Line Data," available at *U.S. Census Bureau*, https://www.census.gov/geo/landview/lv6help/pos_acc.html.

68. Based on the above, it is my professional opinion that coordinate reference system differences between the NAD83 census tract data and the WGS84 geocoded roadblock points did not play a significant role in Dr. Ricchetti's analysis.

3.5. *The relevance of roadblocks located on the boundary between census tracts can be tested using standard methods*

69. Mr. Funderburk incorrectly states that, because 23% of the roadblock locations are located on census tract boundaries, any analysis based on the assignment of these roadblocks to a specific census tract should be rendered invalid.⁵⁰ Below, I will show why this claim is incorrect.

70. Data collected within and aggregated to census tracts are widely used in research to assess the socio-economic characteristics of populations within a study area. The *Harvard Public Health Disparities Geocoding Project* is a multi-year research effort that in numerous publications describes the effective use of associating data collected at geocoded locations with census tract data to assess disparities in access to health care.⁵¹ According to project director Dr. Nancy Krieger:⁵²

“Census tracts not only provide a stable geographic unit for estimating the number and characteristics of the people and housing units located within them, but they have also expanded scientific understanding of the impact of context on the social patterning of the public's well-being, with obvious policy relevance.”

71. Geocoded locations are most commonly associated with census tract data through a process known as “point-in-polygon” overlay.⁵³ This method entails locating geocoded points and census tract boundaries within the same coordinate space (i.e. coordinate reference system). If numerous points (for example, roadblocks) fall within a region (such as a census tract), the data for the region can be matched to

⁵⁰ Funderburk Report, ¶ 58.

⁵¹ For a general summary, see “The Public Health Disparities Geocoding Project,” available at Harvard T.H. Chan School of Public Health, <https://www.hsph.harvard.edu/thegeocodingproject>.

⁵² Krieger, Nancy, “A Century of Census Tracts: Health & the Body Politic (1906–2006),” *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, 83(3), 2006, pp. 355–361.

⁵³ Schootman, Mario, et al., “Positional Accuracy and Geographic Bias of Four Methods of Geocoding in Epidemiologic Research,” *Annals of Epidemiology*, 17(6), 2007, p. 465.

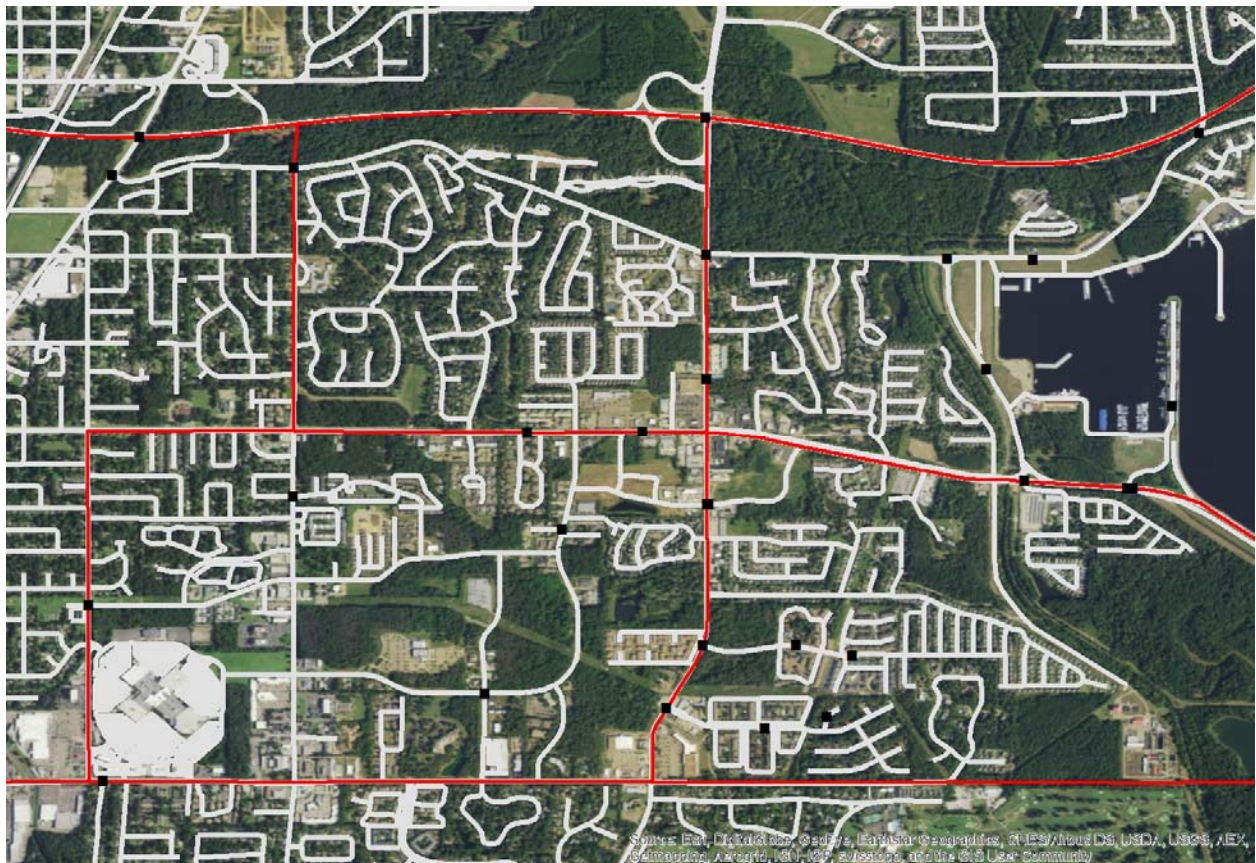
the total number of points. This approach was used by Dr. Ricchetti to count the number of roadblocks within each census tract.

72. There are a number of articles that discuss the challenges of using point-in-polygon overlay to associate census tract data with geocoded points.⁵⁴ There are two key factors: (1) the quality of geocoded locations and (2) the correct assignment of points to census tract polygons. As I have already discussed (1), I focus on (2) below.
73. A key determinant of correct assignment is one of alignment – whether the spatial accuracy of the census tract boundary data supports the accurate identification of points that fall within those tracts. One method to assess this is to display the census tract data on top of aerial imagery and street network data and review the alignment of census boundaries with the street network and other linear features. This will reveal if there are major discrepancies.
74. I undertook this visual review in ArcGIS 10.5.1 using the ESRI Streets base layer and the Business Analyst 2017 geocoding data streets layer. I zoomed in and followed the census tract boundaries. I carefully examined the census boundaries depicted in Exhibit 2 of Dr. Ricchetti’s report that delineate adjacent tracts characterized by a higher and lower black population percentage. Throughout the county I viewed a high degree of concordance between the tract boundaries and the street and water features. A map depicting this alignment is shown below.

⁵⁴ Schootman, Mario, et al., “Positional Accuracy and Geographic Bias of Four Methods of Geocoding in Epidemiologic Research,” *Annals of Epidemiology*, 17(6), 2007, pp. 464–470; Goldberg, Daniel W., John P. Wilson and Craig A. Knoblock, “From Text to Geographic Coordinates: The Current State of Geocoding,” *Journal of the Urban and Regional Information Systems Association*, 19(1), 2007, pp. 33–46; Zandbergen, Paul A., “Geocoding Quality and Implications for Spatial Analysis,” *Geography Compass*, 3(2), 2009, pp. 647–680.

EXHIBIT 3

Map Showing the Alignment of Census Tract Boundaries, Major Streets and Streams, and Roadblock Locations within Madison County.



Source: Census TIGER Line Tract boundary data for Madison County, 2015; ArcGIS Business Analyst.

75. Based on this visual analysis and my professional experience, I conclude (1) that the census tracts align well with the ArcGIS street network and (2) census tract – street alignment issues would not result in roadblock points being assigned to incorrect census tracts unless those points were near a census tract boundary. As shown in the map above, and as reported by Mr. Funderburk, certain roadblock locations are near or along census tract boundaries. This is not an error. It is a

product of the fact that (1) the roadblocks are located on streets and (2) street centerlines are used to form census tract boundaries.⁵⁵

76. Separate from the issue of tract boundary accuracy, Mr. Funderburk claims that the existence of some roadblocks close to the boundary of two or more tracts renders the analysis invalid.⁵⁶ As I explain below, the fact that roadblocks occur in streets that are also census tract boundaries does not render those roadblocks invalid for Dr. Ricchetti's analysis. However, the co-occurrence raises the following questions: (1) how many roadblocks are located on census tract boundaries? (2) how were these roadblocks assigned to census tracts in Dr. Ricchetti's analysis? and (3) what impact did his assignment of these roadblocks have on his analysis? I address these questions below in a geospatial analysis of the data.
77. First, I used ArcGIS 10.5.1 to transform the census tract boundary data and the geocoded point data, listed in the *Compiled Unique Roadblocks* table, to the Mississippi Transverse Mercator NAD83 projection (EPSG:3814). This is the projected coordinate reference system used by MARIS: the Mississippi Automated Resource Information System, a governmental organization tasked with coordinating geographic information data sets in the state.⁵⁷ This was done in order to (1) put all data in the same coordinate reference frame and (2) put all data in a projected (Euclidean) coordinate reference frame that supports distance-based queries and calculations.
78. I then converted the Madison County census tract polygon data to line data using the ArcGIS *Polygon-to-Line* tool. Next, I used the ArcGIS *Select-by-Location* tool to identify all roadblock points located on census tract boundary lines. This operation returned zero results – in other words, none of the roadblock points spatially intersect census tract boundaries, which is consistent with Dr. Ricchetti's analysis.
79. This result is not surprising. Census tract data and reference databases used to geocode locations are created by different organizations using different software at different times with different methods. Therefore, point representations of

⁵⁵ “2017 TIGER/Line Shapefiles Technical Documentation,” available at *U.S. Census Bureau*, https://www2.census.gov/geo/pdfs/maps-data/data/tiger/tgrshp2017/TGRSHP2017_TechDoc_Ch1.pdf.

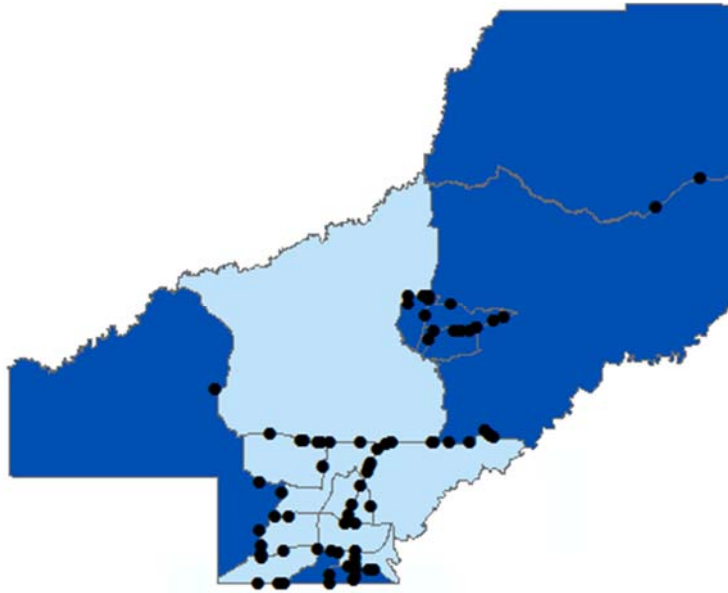
⁵⁶ Funderburk Report, ¶ 58.

⁵⁷ *Mississippi Automated Resource Information System*, <http://www.maris.state.ms.us>.

roadblock locations are highly unlikely to spatially intersect census tract boundaries even if they reside within a street whose centerline forms a census tract boundary. These points will almost always be on one side of the tract boundary line.

80. This is not an issue specific to these data. Consequently, point-line spatial intersection is typically implemented within a buffer tolerance setting to capture the nature of the real world intersection of the phenomena under study.
81. For these data, I re-ran the spatial selection query using a 20 meter (65.6 feet) buffer distance around the census tract boundary lines. Any point within 20 meters of a census tract boundary line would return TRUE for intersecting with that line. The 20 meter buffer distance is specific to this application. This distance is designed to approximate the maximum width of a two-lane street with parking on both sides given that most lane widths vary from approximately three to five meters (9 to 15 feet).
82. The spatial selection query identified 82 roadblock points representing 662 roadblocks within 20 meters of a census tract boundary line. These values are consistent with Mr. Funderburk's findings.⁵⁸
83. The map below shows the location of these border roadblocks relative to the census tract classification scheme used in Exhibit 2 of Dr. Ricchetti's report which clearly demarks census tracts with a relatively higher black population percentage (dark blue) or relatively lower black population percentage (light blue). It is worth noting that four of the purported boundary roadblocks identified by Mr. Funderburk – accounting for 121 roadblocks – are on the border between a single census tract in Madison County and another tract *outside* Madison County. Thus, there is no uncertainty about the assignment to the relevant census tracts for these roadblocks.

⁵⁸ Funderburk Report, ¶ 57.

EXHIBIT 4***Roadblocks within 20 meters of Census Tract Boundaries within Madison County (2012-2017)***

Source: Census TIGER Line Tract boundary data for Madison County, 2015; Compiled List of Unique Roadblocks

84. Assuming that the roadblocks that occurred at one of these point locations along the border of adjoining census tracts could be assigned to any census tract within the 20 meter buffer distance, I used the ArcGIS Generate *Near Table Analysis* tool to identify all census tracts within 20 meters of each of these 82 roadblock points.
85. I joined the resultant *Near Analysis Output* table to the table of *Compiled Unique Roadblocks* by IN_FID, which is the identifier that links these two tables, to have more information about each roadblock point like *clean_address*. Similarly, I joined the census tract tabular data to the Near Analysis Table by NEAR_FID in order to add the census tract identifier (GEOID) for each census tract that was near the input roadblock point.
86. I exported the resulting table to a CSV file to further process it in R, a statistical programming software tool. I joined the tabular data in Exhibit 1 of Dr. Ricchetti's report to the *Near Analysis Output* table in order to have a value for *average black population percentage* for each census tract that was identified by the near analysis.

Using this expanded table, I calculated for each roadblock point the minimum and maximum black population percentages of the census tracts to which it could have been assigned – i.e., the census tracts it bordered.

87. I then identified the roadblock points that could have been but were not assigned to the tract with the maximum black population percentage. I repeated this process to identify the roadblock points that could have been but were not assigned to the tract with the minimum black population percentage. The results of this analysis are included in Appendix D.
88. The summary statistics for this table show that 327 roadblocks occurring at 36 different locations could have been assigned to census tracts with a higher black population percentage. The table also show that 216 roadblocks occurring at 44 different locations could have been assigned to census tracts with a lower black population percentage. In other words, there were more roadblocks that could have been assigned to tracts with a higher black population than roadblocks that could have been assigned to tracts with a lower black population.⁵⁹
89. Contrary to what Mr. Funderburk suggests, this finding does not weaken or invalidate Dr. Ricchetti's analysis. Rather, this result suggests that Dr. Ricchetti's results are, if anything, more conservative than the true distribution.

⁵⁹ Four roadblock points (1, 101, 139, 234) that were the site of a total of 121 roadblocks were near a tract border that was also the border of Madison County and did not border another tract within Madison County. None of these roadblocks could have been assigned to any other tracts in Madison County. Two roadblock points (259, 321), the site of two roadblocks, were near the border of more than two tracts and could have been assigned to a tract with a higher or a lower percent black population.

4. CONCLUSION


90. I find that Dr. Ricchetti's geocoding was accurate, precise, and reliable. Dr. Ricchetti uses a highly regarded geocoding software, ArcGIS World Geocoding Service, to ensure high reliability in his geocoding output. Moreover, Dr. Ricchetti uses a standard metric of geocoding quality to evaluate positional accuracy and precision, the geocoding *match score*. He sets his match score threshold to 90 out of 100 to increase the level accuracy and precision in his geocoding output. Based on the academic literature, this is a relatively high match score cutoff.
91. Mr. Funderburk, on the other hand, claims that Dr. Ricchetti's geocoding was not accurate, precise, or reliable without offering clear definitions of what these terms mean or providing support for these claims. He implements no statistically sound or standard method of evaluating the accuracy, precision, or reliability of the geocoded locations. Mr. Funderburk attempts to use ground truthing to assess positional accuracy but his implementation of the method is not based on best practices. He fails to meet the professional standard of using a randomized sample in his analysis. Thus, any conclusions he draws about positional accuracy cannot be generalized to a statement about the geocoding quality of the data set as a whole.
92. Mr. Funderburk's claim that street intersections cannot be geocoded accurately is simply not supported by my experience or the research literature. As detailed above, the research literature on geocoding does not provide benchmarks for acceptable levels of geocoding positional accuracy and precision. Rather, the literature notes that acceptable levels for these characteristics are dependent on how the results of geocoding will be used.⁶⁰ Mr. Funderburk does not consider the positional accuracy that would be needed to locate a point in a street intersection within a census tract, which is how the geocoded points are used in Dr. Ricchetti's analysis. Setting aside the issue of roadblocks on census tract boundaries, for the purposes of counting roadblocks within a census tract, a location geocoded to any point within a street intersection is perfectly sufficient. Thus, for the vast majority of roadblock locations in Dr. Ricchetti's analysis that were not on the boundary of census tracts, identifying a census tract is very straightforward.
93. Similarly, Mr. Funderburk alleges that the coordinate reference system may be driving several of Dr. Ricchetti's alleged "errors", but this claim is simply

⁶⁰ Zandbergen, Paul A., "Geocoding Quality and Implications for Spatial Analysis," *Geography Compass*, 3(2), 2009, pp. 647–680.

implausible given how small the magnitude of such differences would be given the application at hand.

94. While Mr. Funderburk notes that 82 roadblock locations are located on streets that are census tract boundaries, and thus could be said to straddle multiple census tracts, it is notable that Mr. Funderburk's analysis does not attempt to test how this could affect Dr. Ricchetti's analysis. He simply asserts that this type of measurement error "can have profound impacts on the number of roadblocks per census tract and is not a valid representation of what actually occurred," without offering any robustness test.⁶¹ In my experience and in the research literature, there are standard ways to test whether the potential for error in a subset of data points will impact an analysis.⁶²
95. For example, one could perform exercises in which the roadblocks are assigned to the least and most favorable census tracts relative to the analysis in question. Mr. Funderburk did not perform any such analysis. I, however, performed this analysis on the 82 roadblocks located on census tract boundaries. My results show that Dr. Ricchetti's analysis is more likely to assign roadblocks on census tract borders to the census tract with the relatively *lower share* of the population that is black. Thus, Dr. Ricchetti's geocoding of the boundary roadblocks does not systematically increase the count of roadblocks in census tracts with a relatively high black population percentage.

Executed on July 2, 2018.



Patricia Frontiera, Ph.D.

⁶¹ Funderburk Report, ¶ 53.

⁶² Strickland, Matthew J., et al, "Quantifying Geocode Location Error Using GIS Methods," *Environmental Health*, 6(10), 2007.

Appendix A

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EDUCATION

PH.D	University of California, Berkeley, California. Environmental Planning. 2005. Emphasis on geographic informational retrieval. Dissertation chair: John Radke.
M.L.I.S.	University of California, Berkeley, California. Library & Information Studies. 1992.
B.A.	Wellesley College, Wellesley, Massachusetts. History. 1984

RECENT PROFESSIONAL POSITIONS

2017 - present	Geospatial Data Scientist, Social Sciences Data Lab (D-Lab), UC Berkeley Lead, advise, participate in and collaborate on research projections with a geographic data, mapping and or visualization component. Provide consulting and instructional services to the UC Berkeley community on related topics.
2014 – 2017	Academic Coordinator, Social Sciences Data Lab, UC Berkeley With a team of dedicated and talented colleagues, planned, developed, delivered and coordinated an instructional workshop program to support graduate-level data intensive social science research. Topic lead for trainings related to geospatial data and analysis.

TEACHING EXPERIENCE

2015-17	University of CA, Berkeley, Lecturer, Data Science Education Program <i>Geospatial Data Exploration and Visualization (ESPM88x)</i>
2012	University of CA, Berkeley, Lecturer, City and Regional Planning <i>Introduction to GIS and City Planning (CP204C)</i>
2010	University of CA, Berkeley, Lecturer, Environmental Science & Policy Management <i>Introduction to Geographic Information Systems (ESPM 72)</i>
2005	University of CA, Berkeley, Lecturer, Landscape Architecture <i>Quantitative Methods in Environmental Planning (LA221)</i>

PREVIOUS PROFESSIONAL POSITIONS

- 2008 - 2014 **Senior GIS Technology Specialist**, The San Francisco Estuary Institute
- Research on and development of custom web mapping applications and spatial analysis tools for exploring data and sharing information with a diverse group of stakeholders including scientists, planners, resource managers and the general public.
- 2005 - 2006 **Post-doctoral Researcher**, College of Natural Resources, UC Berkeley
- Researched structure vulnerability to wildfire in the wildland-urban interface. This work served as the basis of the wildfire risk and hazard assessment toolkit developed by the Center for Fire Research and Outreach.
- 1996 - 2003 **GIS Project Manager, Programmer/Analyst III**
Geographic Information Science Center, UC Berkeley, 2003
- Managed all aspects of GIS projects, including preparing work plans and budgets, supervising student employees, advising on and troubleshooting technical issues, and interacting with current and prospective clients as well as with related campus groups.
- Center for Environmental Design Research, UC Berkeley, 1996-2002
- As a member of the research group REGIS (Research Program in Environmental Planning and Geographic Information Systems), pioneered the development and use of open standards and technologies for web-based access to geographic information for natural resource management and environment planning applications
- 1993 – 1996 **Computer Lab Manager**, City and Regional Planning / Landscape Architecture and Environmental Planning, UC Berkeley
Managed hardware and software resources for two departmental computer labs. This included a local area network of 50+ MS Windows-based and Mac computers, UNIX workstations, printers, plotters, scanners, and digitizers.
- 1990-1991 **Circulation Supervisor**, Main Library, UC Berkeley,
- Hired, trained, and supervised two full-time and 20+ part-time student library employees.

PUBLICATIONS AND PRESENTATIONS

- Frontiera, P. (2018 June). Tools and Techniques for Interactive Data Visualizations. Presented at the Berkeley Interdisciplinary Migration Institute Summer Workshop in Migration Research Methods.
- Frontiera, P. (2017, March). *Geospatial Data and the Louisiana Slave Conspiracies Project*. Presented at the Digital Humanities for Caribbean History Workshop, Harvard, MA.

- Frontiera, P. (2016, April). *Comparison of Reference Data used for Geocoding US Addresses*. Presented at the Annual Meeting of the Association of American Geographers, San Francisco, CA.
- Powell, S., von Vacano, C., and Frontiera, P. (2016, April). *Teaching the Geospatial for Digital Humanities*. Presented at the Association of American Geographers Annual Mtg, San Francisco, CA.
- Frontiera, P. (2013, April). *Developing a dynamic web-based landscape profile tool*. Presented at the 19th Annual California GIS Conference (CalGIS), Long Beach, CA.
- Frontiera, P. (2011, May). *Spatial methods for browsing and searching multi-media resource collections*. Invited speaker at the Plenary session of the Nevada GIS Annual Conference, organized by the National Archives and Records Administration, Reno, NV.
- Frontiera, P. (2010). Spatial data integration. In: B. Warf (Ed.) *Encyclopedia of Geography*, Thousand Oaks, CA: Sage.
- Frontiera, P. (2008). *Proceedings of the ACM 17th Conference on Information and Knowledge Management: Flamenco + Geo: extending a search interface based on hierarchical faceted metadata with geographic capabilities*. (GIR'08) Napa, Ca.
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Expert Report

Expert Report of Bryan Ricchetti, Ph D with associated exhibits, appendices, and production	March 13, 2018
Expert Report of William R Funderburk with associated exhibits, appendices, and production	May 8, 2018

Depositions

Deposition of Bryan Ricchetti, Ph D	April 6, 2018
Deposition of William R Funderburk	June 20, 2018

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Other

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Appendix C

Compiled Unique Roadblocks

Point ID <i>rid</i>	Longitude <i>lon</i>	Latitude <i>lat</i>	Clean Address <i>clean_address</i>	Original Address <i>original_address</i>	Census Tract ID <i>geoid</i>	Number of Roadblocks <i>num_rbs</i>
1	-90.17706°	32.40025°	W COUNTY LINE RD AND I-220, MADISON COUNTY, MS	W COUNTY LINE RD / I-220 RID	28089030206	114
2	-90 03243°	32.61859°	DOBSON AVE AND YANDELL AVE, MADISON COUNTY, MS	DOBSON AVE / YANDELL AVE CAN	28089030600	78
3	-90 08861°	32.41169°	LOWER SPILLWAY RD, MADISON COUNTY, MS	LOWER SPILLWAY RD RID	28089030107	65
4	-90.10804°	32.40255°	OLD CANTON RD AND PINE KNOLL DR, MADISON COUNTY, MS	OLD CANTON RD / PINE KNOLL DR RID	28089030106	59
5	-90 01619°	32.61733°	HARGON ST AND COVINGTON DR, MADISON COUNTY, MS	HARGON ST / COVINGTON DR CAN	28089030600	48
6	-90 08585°	32.42646°	POST RD AND RICE RD, MADISON COUNTY, MS	POST RD / RICE RD CAN	28089030107	44
7	-90 08901°	32.70230°	OLD YAZOO CITY RD AND HWY 16, MADISON COUNTY, MS	OLD YAZOO CITY RD / HWY 16 CAN	28089030400	39
8	-90 03373°	32.64035°	W HWY 16 AND GREEN ACRES, MADISON COUNTY, MS	W HWY 16 / GREEN ACRES CAN	28089030600	38
9	-90 02047°	32.64771°	HWY 51 AND MORGAN RD, MADISON COUNTY, MS	HWY 51 / MORGAN RD CAN	28089030900	38
10	-89 98419°	32.63394°	HWY 43 AND GOODLOE RD, MADISON COUNTY, MS	HWY 43 / GOODLOE RD CAN	28089030900	34
11	-90 03488°	32.64034°	GREEN ACRES AND RAILROAD ST, MADISON COUNTY, MS	GREEN ACRES / RAILROAD ST CAN	28089030500	32
12	-89 94762°	32.54045°	PIPELINE RD AND HWY 43, MADISON COUNTY, MS	PIPELINE RD / HWY 43 CAN	28089030900	30
13	-89 93628°	32.62943°	HWY 16 E AND SHARON RD, MADISON COUNTY, MS	HWY 16 E / SHARON RD CAN	28089030900	25
14	-89 97501°	32.52461°	HWY 43 AND NATCHEZ TRACE PKWY, MADISON COUNTY, MS	HWY 43 / NATCHEZ TRACE PKWY CAN	28089030201	25
15	-90 31688°	32.57612°	KEARNEY PARK RD AND MIDDLE RD, MADISON COUNTY, MS	KEARNEY PARK RD / MIDDLE RD FLO	28089030302	23
16	-89 99530°	32.58217°	HWY 43 AND RANKIN RD, MADISON COUNTY, MS	HWY 43 / RANKIN RD CAN	28089030900	23
17	-90.17293°	32.45587°	LAKE CASTLE RD AND RICHARDSON RD, MADISON COUNTY, MS	LAKE CASTLE RD / RICHARDSON RD CAN	28089030204	21
18	-90 09314°	32.41200°	HARBOR AND LAKE HARBOR, MADISON COUNTY, MS	HARBOR / LAKE HARBOR CAN	28089030107	20
19	-89 98714°	32.61306°	HWY 16 AND AVONDALE RD, MADISON COUNTY, MS	HWY 16 / AVONDALE RD CAN	28089030600	19
20	-90.10651°	32.40515°	OLD CANTON RD AND WILLIAM BLVD, MADISON COUNTY, MS	OLD CANTON RD / WILLIAM BLVD RID	28089030106	19
21	-90 04395°	32.58722°	HWY 51 AND CORRECTIONS DR, MADISON COUNTY, MS	HWY 51 / CORRECTIONS DR CAN	28089030400	19
22	-90.10635°	32.41099°	HARBOUR PT XING AND OLD CANTON, MADISON COUNTY, MS	HARBOUR PT XING / OLD CANTON RID	28089030106	18
23	-90 00993°	32.66200°	HWY 51 AND STUMP BRIDGE RD, MADISON COUNTY, MS	HWY 51 / STUMP BRIDGE RD CAN	28089030900	18
24	-90 34702°	32.58657°	LIVINGSTON VERNON RD AND HWY 49, MADISON COUNTY, MS	LIVINGSTON VERNON RD / HWY 49 CAN	28089030302	17
25	-90.13207°	32.40682°	TOWNE CENTER AND WHEATLEY, MADISON COUNTY, MS	TOWNE CENTER / WHEATLEY RID	28089030106	17
26	-90 03995°	32.61873°	RAILROAD ST AND GEORGE WASHINGTO, MADISON COUNTY, MS	RAILROAD ST / GEORGE WASHINGTO CAN	28089030500	16
27	-90 00690°	32.59394°	S HWY 43 AND CANTON PARKWAY, MADISON COUNTY, MS	S HWY 43 / CANTON PARKWAY CAN	28089030800	15
28	-90 05064°	32.61831°	388 RICKS DR, MADISON COUNTY, MS	388 RICKS DR CAN	28089030500	15
29	-90.21576°	32.55336°	HWY 463 AND HWY 22, MADISON COUNTY, MS	HWY 463 / HWY 22 CAN	28089030400	14
30	-90.05895°	32.60921°	W PEACE ST AND PLUMNER DR, MADISON COUNTY, MS	W PEACE ST / PLUMNER DR CAN	28089030500	14
31	-90.03978°	32.56027°	N OLD CANTON RD AND ENDRIS, MADISON COUNTY, MS	N OLD CANTON RD / ENDRIS CAN	28089030400	13
32	-90.03453°	32.62375°	N UNION ST AND MARTIN LUTHER KING, MADISON COUNTY, MS	N UNION ST / MARTIN LUTHER KING CAN	28089030600	13
33	-90.19194°	32.52423°	HWY 463 AND GLUCKSTADT RD, MADISON COUNTY, MS	HWY 463 / GLUCKSTADT RD MAD	28089030301	12
34	-89.75151°	32.76045°	HWY 43 AND CAUTHEN RD, MADISON COUNTY, MS	HWY 43 / CAUTHEN RD CAN	28089031000	12
35	-90.05486°	32.61625°	FOLEY AVE AND KING RANCH RD, MADISON COUNTY, MS	FOLEY AVE / KING RANCH RD CAN	28089030500	12
36	-90.04443°	32.61505°	MARTIN LUTHER KING DR AND N UNIO, MADISON COUNTY, MS	MARTIN LUTHER KING DR / N UNIO CAN	28089030500	11
37	-90.19989°	32.42081°	LIVINGSTON RD AND OLD AGENCY RD, MADISON COUNTY, MS	LIVINGSTON RD / OLD AGENCY RD CAN	28089030206	11
38	-90.08933°	32.60985°	VIRLILIA RD AND OLD YAZOO CITY R, MADISON COUNTY, MS	VIRLILIA RD / OLD YAZOO CITY R CAN	28089030400	11
39	-90.17659°	32.40026°	I-220 AND W COUNTY LINE RD, MADISON COUNTY, MS	I-220 / W COUNTY LINE RD CAN	28089030206	11
40	-89.96871°	32.84816°	HWY 51 AND HWY 17, MADISON COUNTY, MS	HWY 51 / HWY 17 CAN	28089031000	11
41	-89.94247°	32.71290°	SHARON RD AND STUMP BRIDGE RD, MADISON COUNTY, MS	SHARON RD / STUMP BRIDGE RD CAN	28089030900	11
42	-90.08634°	32.43253°	WRIGHTS MILL DR AND RICE RD, MADISON COUNTY, MS	WRIGHTS MILL DR / RICE RD MAD	28089030101	11
43	-90.18657°	32.45495°	N LIVINGSTON RD AND LAKE CASTLE RD, MADISON COUNTY, MS	N LIVINGSTON RD / LAKE CASTLE RD MAD	28089030302	10
44	-89.93623°	32.65844°	HWY 43 AND SHARON RD, MADISON COUNTY, MS	HWY 43 / SHARON RD CAN	28089030900	10
45	-90.27290°	32.49579°	ROBINSON SPRINGS RD AND POCAHONTAS, MADISON COUNTY, MS	ROBINSON SPRINGS RD / POCAHONTAS FLO	28089030302	10
46	-90.10394°	32.40173°	PINE KNOLL DR, MADISON COUNTY, MS	PINE KNOLL DR RID	28089030108	9
47	-90.04323°	32.62372°	619 MARTIN LUTHER KING DR, MADISON COUNTY, MS	619 MARTIN LUTHER KING DR CAN	28089030500	9

Compiled Unique Roadblocks

Point ID <i>rid</i>	Longitude <i>lon</i>	Latitude <i>lat</i>	Clean Address <i>clean_address</i>	Original Address <i>original_address</i>	Census Tract ID <i>geoid</i>	Number of Roadblocks <i>num_rbs</i>
48	-90 07125°	32.53918°	HWY 51 AND SOWELL RD, MADISON COUNTY, MS	HWY 51 / SOWELL RD CAN	28089030400	9
49	-89 97754°	32.52706°	HWY 43 AND YANDELL RD, MADISON COUNTY, MS	HWY 43 / YANDELL RD CAN	28089030201	9
50	-90 24606°	32.56062°	LIVINGSTON VERNON RD AND STOKES, MADISON COUNTY, MS	LIVINGSTON VERNON RD / STOKES CAN	28089030302	8
51	-89 99343°	32.51694°	YANDELL RD AND TWELVE OAKS TRACE, MADISON COUNTY, MS	YANDELL RD / TWELVE OAKS TRACE CAN	28089030201	8
52	-90 06342°	32.46510°	HOY RD AND OLD RICE RD, MADISON COUNTY, MS	HOY RD / OLD RICE RD MAD	28089030201	8
53	-90 08884°	32.41167°	SPILLWAY RD AND BREAKERS LN, MADISON COUNTY, MS	SPILLWAY RD / BREAKERS LN RID	28089030108	8
54	-90 04675°	32.61854°	BOYD ST AND GEORGE WASHINGTON AV, MADISON COUNTY, MS	BOYD ST / GEORGE WASHINGTON AV CAN	28089030500	8
55	-90 03732°	32.62369°	JAMES ST AND MARTIN LUTHER KING, MADISON COUNTY, MS	JAMES ST / MARTIN LUTHER KING CAN	28089030600	8
56	-90 00256°	32.69114°	HWY 51 AND DAVIS CROSSING, MADISON COUNTY, MS	HWY 51 / DAVIS CROSSING CAN	28089030900	7
57	-90.13654°	32.58305°	HWY 22 AND CATLETT RD, MADISON COUNTY, MS	HWY 22 / CATLETT RD CAN	28089030400	7
58	-89 99523°	32.56037°	HWY 43 AND ENDRIS RD, MADISON COUNTY, MS	HWY 43 / ENDRIS RD CAN	28089030900	7
59	-90.14375°	32.42818°	NATCHEZ TRACE PKWY AND I-55, MADISON COUNTY, MS	NATCHEZ TRACE PKWY / I-55 RID	28089030105	7
60	-90 05764°	32.47233°	OLD RICE RD AND SHADOW HILL DR, MADISON COUNTY, MS	OLD RICE RD / SHADOW HILL DR CAN	28089030201	7
61	-90 03806°	32.51933°	OLD CANTON RD AND YANDELL RD, MADISON COUNTY, MS	OLD CANTON RD / YANDELL RD CAN	28089030400	7
62	-90 04861°	32.58060°	HWY 51 AND NISSAN PKWY, MADISON COUNTY, MS	HWY 51 / NISSAN PKWY CAN	28089030400	7
63	-90.17767°	32.53667°	124 N I-55, MADISON COUNTY, MS	124 N I-55 CAN	28089030400	7
64	-90 20086°	32.44432°	LAKE CAVALIER RD AND N LIVINGSTO, MADISON COUNTY, MS	LAKE CAVALIER RD / N LIVINGSTO MAD	28089030302	7
65	-90 30367°	32.51155°	HWY 49 AND PETRIFIED FOREST RD, MADISON COUNTY, MS	HWY 49 / PETRIFIED FOREST RD CAN	28089030302	6
66	-90 08624°	32.43537°	BREEZY HILL DR AND RICE RD, MADISON COUNTY, MS	BREEZY HILL DR / RICE RD MAD	28089030101	6
67	-90.12352°	32.42500°	RICE RD AND PEAR ORCHARD RD, MADISON COUNTY, MS	RICE RD / PEAR ORCHARD RD RID	28089030104	6
68	-90.10031°	32.40473°	WILLIAM BLVD, MADISON COUNTY, MS	WILLIAM BLVD CAN	28089030108	6
69	-90 04859°	32.62272°	HOLMES AVE AND MACE ST, MADISON COUNTY, MS	HOLMES AVE / MACE ST CAN	28089030500	6
70	-90 33251°	32.57169°	HWY 49 AND MIDDLE RD, MADISON COUNTY, MS	HWY 49 / MIDDLE RD CAN	28089030302	6
71	-89 99081°	32.74889°	HWY 51 AND WAY RD, MADISON COUNTY, MS	HWY 51 / WAY RD CAN	28089031000	6
72	-90 03845°	32.62370°	RAILROAD ST AND MARTIN LUTHER KI, MADISON COUNTY, MS	RAILROAD ST / MARTIN LUTHER KI CAN	28089030500	6
73	-90 03853°	32.62370°	MARTIN LUTHER KING DR AND RAILRO, MADISON COUNTY, MS	MARTIN LUTHER KING DR / RAILRO CAN	28089030500	6
74	-90 03064°	32.62256°	RICHARD CIR, MADISON COUNTY, MS	RICHARD CIR CAN	28089030600	5
75	-89 87284°	32.69706°	HWY 43 AND SULPHUR SPRINGS RD, MADISON COUNTY, MS	HWY 43 / SULPHUR SPRINGS RD CAN	28089030900	5
76	-90.13625°	32.55328°	STOUT RD AND CATLETT RD, MADISON COUNTY, MS	STOUT RD / CATLETT RD CAN	28089030400	5
77	-90.10902°	32.41405°	LAKE HARBOUR DRIVE AND RANKIN, MADISON COUNTY, MS	Lake Harbour Drive / Rankin	28089030104	5
78	-90 08939°	32.59407°	OLD JACKSON RD AND HWY 22, MADISON COUNTY, MS	OLD JACKSON RD / HWY 22 CAN	28089030400	5
79	-90 02678°	32.63860°	RR AND GREEN ACRES, MADISON COUNTY, MS	RR / GREEN ACRES CAN	28089030600	5
80	-90.15769°	32.51791°	GLUCKSTADT RD AND DEWEES RD, MADISON COUNTY, MS	GLUCKSTADT RD / DEWEES RD CAN	28089030301	5
81	-90 09998°	32.58411°	HWY 22 AND CALHOUN PKWY, MADISON COUNTY, MS	HWY 22 / CALHOUN PKWY CAN	28089030400	5
82	-90 04471°	32.58624°	2935 HWY 51, MADISON COUNTY, MS	2935 HWY 51 CAN	28089030400	5
83	-90.17540°	32.42945°	122 NATCHEZ TRACE PKWY, MADISON COUNTY, MS	122 NATCHEZ TRACE PKWY CAN	28089030205	5
84	-89 90604°	32.63900°	HWY 16 AND RATLIFF FERRY RD, MADISON COUNTY, MS	HWY 16 / RATLIFF FERRY RD CAN	28089030900	5
85	-89 80946°	32.71561°	HWY 17 AND SULPHUR SPRINGS RD, MADISON COUNTY, MS	HWY 17 / SULPHUR SPRINGS RD CAN	28089031000	5
86	-90 36658°	32.49876°	HWY 22 AND SPRING CREEK RD, MADISON COUNTY, MS	HWY 22 / SPRING CREEK RD CAN	28089030302	5
87	-90 04675°	32.61502°	BOYD ST AND WEST NORTH, MADISON COUNTY, MS	BOYD ST / WEST NORTH CAN	28089030500	5
88	-90 30414°	32.54594°	HWY 22 AND BANNERMAN DR, MADISON COUNTY, MS	HWY 22 / BANNERMAN DR FLO	28089030302	5
89	-90.13200°	32.51692°	GLUCKSTADT RD AND CATLETT RD, MADISON COUNTY, MS	GLUCKSTADT RD / CATLETT RD CAN	28089030400	4
90	-90 09339°	32.58894°	NISSAN PKWY AND HWY 22, MADISON COUNTY, MS	NISSAN PKWY / HWY 22 CAN	28089030400	4
91	-90 04230°	32.61015°	CANAL ST AND W ACADEMY ST, MADISON COUNTY, MS	CANAL ST / W ACADEMY ST CAN	28089030500	4
92	-90 08905°	32.54971°	OLD JACKSON RD AND I-55, MADISON COUNTY, MS	OLD JACKSON RD / I-55 MAD	28089030400	4
93	-90 03763°	32.62758°	RAILROAD ST, MADISON COUNTY, MS	RAILROAD ST CAN	28089030500	4
94	-90 04050°	32.49149°	N OLD CANTON RD AND DAVE BROWN RD, MADISON COUNTY, MS	N OLD CANTON RD / DAVE BROWN RD CAN	28089030201	4

Compiled Unique Roadblocks

Point ID <i>rid</i>	Longitude <i>lon</i>	Latitude <i>lat</i>	Clean Address <i>clean_address</i>	Original Address <i>original_address</i>	Census Tract ID <i>geoid</i>	Number of Roadblocks <i>num_rbs</i>
95	-89 83875°	32.78221°	LORING RD AND HWY 17, MADISON COUNTY, MS	LORING RD / HWY 17 CAN	28089031000	4
96	-90 04422°	32.62127°	MLK AND ADELINE ST, MADISON COUNTY, MS	MLK / ADELINE ST CAN	28089030500	4
97	-89 82129°	32.74313°	HWY 17 AND HWY 43, MADISON COUNTY, MS	HWY 17 / HWY 43 CAN	28089031000	4
98	-90 07178°	32.51710°	YANDELL RD AND CLARKDELL RD, MADISON COUNTY, MS	YANDELL RD / CLARKDELL RD CAN	28089030400	4
99	-90 30883°	32.54264°	RAILROAD AV AND CMU, MADISON COUNTY, MS	RAILROAD AV / CMU CAN	28089030302	4
100	-90 07054°	32.51711°	YANDELL RD AND MADISON CROSSING, MADISON COUNTY, MS	YANDELL RD / MADISON CROSSING MAD	28089030400	4
101	-90.18200°	32.40020°	W COUNTY LINE AND HIGHLAND COLONY, MADISON COUNTY, MS	W COUNTY LINE / HIGHLAND COLONY CAN	28089030206	4
102	-90 04027°	32.61506°	RAILROAD ST AND W NORTH ST, MADISON COUNTY, MS	RAILROAD ST / W NORTH ST CAN	28089030500	4
103	-90 04423°	32.61856°	GEORGE WASHINGTON AVE AND KING R, MADISON COUNTY, MS	GEORGE WASHINGTON AVE / KING R CAN	28089030500	4
104	-90 03175°	32.62266°	RICHARD CIR AND DOBSON AVE, MADISON COUNTY, MS	RICHARD CIR / DOBSON AVE CAN	28089030600	4
105	-89 98656°	32.77806°	HWY 51 AND LORING RD, MADISON COUNTY, MS	HWY 51 / LORING RD CAN	28089031000	4
106	-90 03940°	32.61135°	CAMERON ST AND W FULTON ST, MADISON COUNTY, MS	CAMERON ST / W FULTON ST CAN	28089030700	4
107	-89.76596°	32.74020°	SULPHUR SPRING RD AND GIN RD, MADISON COUNTY, MS	SULPHUR SPRING RD / GIN RD CAN	28089030900	4
108	-90 09547°	32.49241°	HWY 51 AND GREEN OAK LN, MADISON COUNTY, MS	HWY 51 / GREEN OAK LN CAN	28089030204	4
109	-90.10649°	32.44727°	OLD CANTON RD AND CALUMET DR, MADISON COUNTY, MS	OLD CANTON RD / CALUMET DR CAN	28089030101	4
110	-90.10625°	32.41099°	HARBOUR POINTE CROSSING AND NORT, MADISON COUNTY, MS	HARBOUR POINTE CROSSING / NORT RID	28089030108	4
111	-90 26584°	32.55144°	HWY 22 AND ANDOVER DR, MADISON COUNTY, MS	HWY 22 / ANDOVER DR CAN	28089030302	4
112	-90 28812°	32.58969°	LIVINGSTON VERNON RD AND ST CHAR, MADISON COUNTY, MS	LIVINGSTON VERNON RD / ST CHAR FLO	28089030302	3
113	-90 09117°	32.46505°	HOY RD AND RICE RD, MADISON COUNTY, MS	HOY RD / RICE RD MAD	28089030202	3
114	-90.16108°	32.44203°	STEED RD AND RICHARDSON RD, MADISON COUNTY, MS	STEED RD / RICHARDSON RD CAN	28089030205	3
115	-90 01183°	32.63320°	FINNEY RD AND MORGAN RD, MADISON COUNTY, MS	FINNEY RD / MORGAN RD CAN	28089030600	3
116	-89 93620°	32.61851°	ROBINSON RD AND SHARON RD, MADISON COUNTY, MS	ROBINSON RD / SHARON RD CAN	28089030900	3
117	-90.18071°	32.49437°	REUNION PKWY AND HWY 463, MADISON COUNTY, MS	REUNION PKWY / HWY 463 MAD	28089030301	3
118	-90 20074°	32.48393°	ROBINSON SPRINGS RD AND POC, MADISON COUNTY, MS	ROBINSON SPRINGS RD / POC CAN	28089030302	3
119	-90 03204°	32.63382°	1415 W HWY 16, MADISON COUNTY, MS	1415 W HWY 16 CAN	28089030600	3
120	-90.19274°	32.53379°	HWY 463 AND STRIBLING RD, MADISON COUNTY, MS	HWY 463 / STRIBLING RD MAD	28089030400	3
121	-90 02982°	32.63197°	W HWY 16 AND HWY 51, MADISON COUNTY, MS	W HWY 16 / HWY 51 CAN	28089030600	3
122	-90.10952°	32.46509°	HWY 463 AND MADISON MIDDLE, MADISON COUNTY, MS	HWY 463 / MADISON MIDDLE CAN	28089030203	3
123	-90 04636°	32.62125°	ADELINE ST AND SINGLETON ST, MADISON COUNTY, MS	ADELINE ST / SINGLETON ST CAN	28089030500	3
124	-89 96964°	32.52200°	HWY 43 AND TURCOTTE LAB DR, MADISON COUNTY, MS	HWY 43 / TURCOTTE LAB DR CAN	28089030900	3
125	-89.76804°	32.75790°	HWY 43 AND GIN RD, MADISON COUNTY, MS	HWY 43 / GIN RD CAR	28089031000	3
126	-90 04845°	32.58081°	HWY 51 AND HWY 16 W, MADISON COUNTY, MS	HWY 51 / HWY 16 W CAN	28089030400	3
127	-90 07056°	32.51712°	300 YANDELL RD, MADISON COUNTY, MS	300 YANDELL RD CAN	28089030400	3
128	-90 03489°	32.61564°	HWY 16 AND HWY 51, MADISON COUNTY, MS	HWY 16 / HWY 51 CAN	28089030600	3
129	-90 05051°	32.54239°	SMITH CARR AND E SOWELL RD, MADISON COUNTY, MS	SMITH CARR / E SOWELL RD CAN	28089030400	3
130	-90 28852°	32.51952°	POCAHONTAS RD AND MT LEOPARD RD, MADISON COUNTY, MS	POCAHONTAS RD / MT LEOPARD RD FLO	28089030302	3
131	-90 04566°	32.61856°	GEORGE WASHINGTON AVE AND RR, MADISON COUNTY, MS	GEORGE WASHINGTON AVE / RR CAN	28089030500	3
132	-90 02171°	32.62303°	INDUSTRIAL DR AND MATTHEWS AVE, MADISON COUNTY, MS	INDUSTRIAL DR / MATTHEWS AVE CAN	28089030600	3
133	-90.18177°	32.40091°	HIGHLAND COLONY PKWY, MADISON COUNTY, MS	HIGHLAND COLONY PKWY MAD	28089030206	3
134	-90 05479°	32.62356°	HOLMES AVE AND KING RANCH RD, MADISON COUNTY, MS	HOLMES AVE / KING RANCH RD CAN	28089030500	3
135	-90 31086°	32.58966°	LIVINGSTON VERNON RD AND HARRIS, MADISON COUNTY, MS	LIVINGSTON VERNON RD / HARRIS FLO	28089030302	3
136	-90 03756°	32.69114°	WAY RD AND DAVIS CROSSING RD, MADISON COUNTY, MS	WAY RD / DAVIS CROSSING RD CAN	28089030400	3
137	-90 02915°	32.62176°	WILSON ST AND RICHARD CIR, MADISON COUNTY, MS	WILSON ST / RICHARD CIR CAN	28089030600	3
138	-89 83578°	32.66105°	HWY 16 EAST AND PAT LUCKETT RD, MADISON COUNTY, MS	HWY 16 EAST / PAT LUCKETT RD CAN	28089030900	2
139	-90 20283°	32.40014°	N LIVINGSTON RD AND COUNTY LINE, MADISON COUNTY, MS	N LIVINGSTON RD / COUNTY LINE CAN	28089030206	2
140	-89.74710°	32.67308°	WALNUT RD AND NATCHEZ TRACE PKWY, MADISON COUNTY, MS	WALNUT RD / NATCHEZ TRACE PKWY CAN	28089030900	2
141	-90.12996°	32.42631°	HWY 51 AND NATCHEZ TRACE, MADISON COUNTY, MS	HWY 51 / NATCHEZ TRACE RID	28089030101	2

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142	-90 05891°	32.67738°	N HWY 55 AND 124, MADISON COUNTY, MS	N HWY 55 / 124 CAN	28089030400	2
143	-90 06363°	32.58545°	NISSAN PKWY AND NISSAN DR, MADISON COUNTY, MS	NISSAN PKWY / NISSAN DR CAN	28089030400	2
144	-90 03809°	32.52589°	OLD CANTON RD AND HARVEY CROSSIN, MADISON COUNTY, MS	OLD CANTON RD / HARVEY CROSSIN CAN	28089030400	2
145	-89 87010°	32.69686°	SULPHUR SPRINGS RD AND POTLUCK R, MADISON COUNTY, MS	SULPHUR SPRINGS RD / POTLUCK R CAN	28089030900	2
146	-90 04002°	32.61634°	RAILROAD ST AND BOWMAN ST, MADISON COUNTY, MS	RAILROAD ST / BOWMAN ST CAN	28089030500	2
147	-89 99324°	32.53900°	HWY 43 AND COTTON BLOSSOM RD, MADISON COUNTY, MS	HWY 43 / COTTON BLOSSOM RD CAN	28089030900	2
148	-89 85848°	32.60366°	RATLIFF FERRY RD AND BOYD DR, MADISON COUNTY, MS	RATLIFF FERRY RD / BOYD DR CAN	28089030900	2
149	-90 04962°	32.62435°	707 MACE ST, MADISON COUNTY, MS	707 MACE ST CAN	28089030500	2
150	-90 07275°	32.48780°	CLARKDELL RD AND GREEN OAK LN, MADISON COUNTY, MS	CLARKDELL RD / GREEN OAK LN CAN	28089030201	2
151	-90 07205°	32.51708°	YANDELL RD AND BRACEY RD, MADISON COUNTY, MS	YANDELL RD / BRACEY RD CAN	28089030400	2
152	-90 08808°	32.54776°	NISSAN DR AND OLD JACKSON RD, MADISON COUNTY, MS	NISSAN DR / OLD JACKSON RD CAN	28089030400	2
153	-90 05885°	32.56297°	HWY 51 AND LINKS DR, MADISON COUNTY, MS	HWY 51 / LINKS DR CAN	28089030400	2
154	-90.19946°	32.42228°	N LIVINGSTON RD AND NATCHEZ TRACE BRIDGE, MADISON COUNTY, MS	N LIVINGSTON RD / NATCHEZ TRACE BRIDGE MAD	28089030206	2
155	-90.17494°	32.56565°	MCMILLON RD AND HWY 22, MADISON COUNTY, MS	MCMILLON RD / HWY 22 MAD	28089030400	2
156	-90 07837°	32.54092°	SOWELL RD AND SOWELL RD, MADISON COUNTY, MS	SOWELL RD / SOWELL RD MAD	28089030400	2
157	-89 96033°	32.62167°	E HWY 16 AND ROYAL OAK RD, MADISON COUNTY, MS	E HWY 16 / ROYAL OAK RD CAN	28089030600	2
158	-90 02995°	32.61016°	ACADEMY ST AND LYON ST, MADISON COUNTY, MS	ACADEMY ST / LYON ST CAN	28089030800	2
159	-90 09471°	32.41666°	HARBOR DR, MADISON COUNTY, MS	HARBOR DR CAN	28089030107	2
160	-90 22270°	32.43443°	GREENS CROSSING RD, MADISON COUNTY, MS	GREENS CROSSING RD MAD	28089030302	2
161	-90 07616°	32.51581°	YANDELL RD AND CLARKDELL RD EXT, MADISON COUNTY, MS	YANDELL RD / CLARKDELL RD EXT CAN	28089030400	2
162	-90 03642°	32.60406°	UNION ST AND W DINKINS ST, MADISON COUNTY, MS	UNION ST / W DINKINS ST CAN	28089030700	2
163	-90 33125°	32.53838°	HWY 22 AND CHILDRESS LN, MADISON COUNTY, MS	HWY 22 / CHILDRESS LN CAN	28089030302	2
164	-90 22630°	32.47419°	COKER RD AND LAKE CAVALIER RD, MADISON COUNTY, MS	COKER RD / LAKE CAVALIER RD MAD	28089030302	2
165	-89 98380°	32.79604°	HWY 51 AND 2 J'S, MADISON COUNTY, MS	HWY 51 / 2 J'S CAN	28089031000	2
166	-90 03491°	32.60404°	S LIBERTY ST AND W DINKINS ST, MADISON COUNTY, MS	S LIBERTY ST / W DINKINS ST CAN	28089030700	2
167	-90 05691°	32.68186°	W HWY 16 AND I-55, MADISON COUNTY, MS	W HWY 16 / I-55 CAN	28089030400	2
168	-90 05068°	32.60635°	WESTSIDE DR AND ROSEBUD DR, MADISON COUNTY, MS	WESTSIDE DR / ROSEBUD DR CAN	28089030500	2
169	-90 08910°	32.55703°	OLD JACKSON RD AND STOUT RD, MADISON COUNTY, MS	OLD JACKSON RD / STOUT RD CAN	28089030400	2
170	-90 05154°	32.62369°	1106 HOLMES AV, MADISON COUNTY, MS	1106 HOLMES AV CAN	28089030500	2
171	-89 90176°	32.62046°	RATLIFF FERRY RD AND ROBINSON RD, MADISON COUNTY, MS	RATLIFF FERRY RD / ROBINSON RD CAN	28089030900	2
172	-90 08939°	32.53932°	W SOWELL RD AND OLD JACKSON RD, MADISON COUNTY, MS	W SOWELL RD / OLD JACKSON RD CAN	28089030400	2
173	-90 09277°	32.42121°	831 RICE RD, MADISON COUNTY, MS	831 RICE RD RID	28089030107	2
174	-90 03481°	32.61856°	YANDELL AVE AND N LIBERTY ST, MADISON COUNTY, MS	YANDELL AVE / N LIBERTY ST CAN	28089030600	2
175	-90 02471°	32.62009°	INDUSTRIAL DR AND LINCOLN ST, MADISON COUNTY, MS	INDUSTRIAL DR / LINCOLN ST CAN	28089030600	2
176	-90 08908°	32.64043°	HEINDL RD AND OLD YAZOO CITY RD, MADISON COUNTY, MS	HEINDL RD / OLD YAZOO CITY RD CAN	28089030400	2
177	-90.13915°	32.49762°	BOZEMAN RD AND REUNION ANNANDALE, MADISON COUNTY, MS	BOZEMAN RD / REUNION ANNANDALE CAN	28089030301	2
178	-90 04214°	32.61342°	N CANAL ST AND FRANKLIN ST, MADISON COUNTY, MS	N CANAL ST / FRANKLIN ST CAN	28089030500	2
179	-90 00771°	32.60390°	HWY 43 AND DINKINS ST, MADISON COUNTY, MS	HWY 43 / DINKINS ST CAN	28089030800	2
180	-90 05140°	32.62360°	HOLMES AV, MADISON COUNTY, MS	HOLMES AV CAN	28089030500	2
181	-90 05552°	32.62804°	DORIS FRANCIS BLVD AND HARRINGTO, MADISON COUNTY, MS	DORIS FRANCIS BLVD / HARRINGTO CAN	28089030500	2
182	-90 02713°	32.61855°	LINCOLN ST AND YANDELL AVE, MADISON COUNTY, MS	LINCOLN ST / YANDELL AVE CAN	28089030600	2
183	-90.15708°	32.47879°	HWY 463 AND MANNSDALE, MADISON COUNTY, MS	HWY 463 / MANNSDALE CAN	28089030204	2
184	-90 08881°	32.58500°	NISSAN PKWY AND OLD JACKSON RD, MADISON COUNTY, MS	NISSAN PKWY / OLD JACKSON RD CAN	28089030400	2
185	-90 39897°	32.54276°	COX FERRY RD AND PHILLIPS RD, MADISON COUNTY, MS	COX FERRY RD / PHILLIPS RD CAN	28089030302	1
186	-90 06363°	32.58545°	NISSAN DR AND NISSAN PKWY, MADISON COUNTY, MS	NISSAN DR / NISSAN PKWY CAN	28089030400	1
187	-90 09473°	32.54018°	SOWELL RD AND I-55, MADISON COUNTY, MS	SOWELL RD / I-55 MAD	28089030400	1
188	-90.10644°	32.45044°	OLD CANTON RD AND ST AUGUSTINE D, MADISON COUNTY, MS	OLD CANTON RD / ST AUGUSTINE D MAD	28089030101	1

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189	-90.19880°	32.43164°	N LIVINGSTON RD AND COU, MADISON COUNTY, MS	N LIVINGSTON RD / COU CAN	28089030302	1
190	-90.08907°	32.57500°	OLD JACKSON RD AND BEAL RD, MADISON COUNTY, MS	OLD JACKSON RD / BEAL RD CAN	28089030400	1
191	-90.10415°	32.50607°	PARKWAY EAST AND INDUSTRIAL DR S, MADISON COUNTY, MS	PARKWAY EAST / INDUSTRIAL DR S MAD	28089030204	1
192	-89.85936°	32.65295°	E HWY 16 AND HOGUE RD, MADISON COUNTY, MS	E HWY 16 / HOGUE RD CAN	28089030900	1
193	-90.07460°	32.51260°	CLARKDELL RD EXT AND YAN, MADISON COUNTY, MS	CLARKDELL RD EXT / YAN CAN	28089030201	1
194	-90.11701°	32.45051°	HWY 51 AND ST AUGUSTINE DR, MADISON COUNTY, MS	HWY 51 / ST AUGUSTINE DR MAD	28089030101	1
195	-90.07709°	32.54250°	W SOWELL RD AND RR TRACKS, MADISON COUNTY, MS	W SOWELL RD / RR TRACKS MAD	28089030400	1
196	-90.16147°	32.51903°	463 AND GLUCKSTADT RD, MADISON COUNTY, MS	463 / GLUCKSTADT RD CAN	28089030301	1
197	-90.05438°	32.61625°	FOLEY AVE AND SUNSET AVE, MADISON COUNTY, MS	FOLEY AVE / SUNSET AVE CAN	28089030500	1
198	-90.03641°	32.60582°	S UNION ST AND CAR WASH, MADISON COUNTY, MS	S UNION ST / CAR WASH CAN	28089030700	1
199	-90.05148°	32.56248°	147 LINKS DR, MADISON COUNTY, MS	147 LINKS DR CAN	28089030400	1
200	-89.84158°	32.62989°	MIGGINS RD AND ROBINSON RD, MADISON COUNTY, MS	MIGGINS RD / ROBINSON RD CAN	28089030900	1
201	-90.03671°	32.64455°	130 JOHNSON HILL RD, MADISON COUNTY, MS	130 Johnson Hill Rd	28089030400	1
202	-90.30957°	32.54312°	KEARNEY PARK RD AND HWY 22, MADISON COUNTY, MS	KEARNEY PARK RD / HWY 22 CAN	28089030302	1
203	-89.97251°	32.52276°	HWY 43 AND BROWNS LANDING RD, MADISON COUNTY, MS	HWY 43 / BROWNS LANDING RD CAN	28089030201	1
204	-90.14530°	32.40591°	HWY 51 HWY 17, MADISON COUNTY, MS	HWY 51 HWY 17 CAN	28089030105	1
205	-90.11557°	32.40315°	NORTHPARK DR AND AVERY BLVD, MADISON COUNTY, MS	NORTHPARK DR / AVERY BLVD RID	28089030106	1
206	-90.04945°	32.61853°	RR AND GEORGE WASHINGTON, MADISON COUNTY, MS	RR / GEORGE WASHINGTON CAN	28089030500	1
207	-89.98096°	32.53080°	HWY 43 AND RAMAGE RD, MADISON COUNTY, MS	HWY 43 / RAMAGE RD CAN	28089030900	1
208	-90.02631°	32.60899°	ADAMS STREET AND PEAR STREET, MADISON COUNTY, MS	Adams Street / Pear Street	28089030800	1
209	-90.02434°	32.62009°	INDUSTRIAL DR AND MILLER ST, MADISON COUNTY, MS	INDUSTRIAL DR / MILLER ST CAN	28089030600	1
210	-90.14375°	32.54635°	CAROLINE BLVD AND BELLEVUE DR, MADISON COUNTY, MS	CAROLINE BLVD / BELLEVUE DR CAN	28089030400	1
211	-90.05476°	32.63267°	HEINDL RD AND KING RANCH RD, MADISON COUNTY, MS	HEINDL RD / KING RANCH RD CAN	28089030500	1
212	-90.05071°	32.61852°	GEORGE WASHINGTON AVE AND RICKS, MADISON COUNTY, MS	GEORGE WASHINGTON AVE / RICKS CAN	28089030500	1
213	-90.08624°	32.43536°	RICE AND WOODS CROSSING BLVD, MADISON COUNTY, MS	RICE / WOODS CROSSING BLVD CAN	28089030101	1
214	-90.04424°	32.61856°	MARTIN LUTHER KING DR AND GEORGE, MADISON COUNTY, MS	MARTIN LUTHER KING DR / GEORGE CAN	28089030500	1
215	-90.13109°	32.42473°	RICE RD AND HWY 51, MADISON COUNTY, MS	RICE RD / HWY 51 CAN	28089030105	1
216	-90.10944°	32.57921°	HWY 22 AND LAKESHIRE PKWY, MADISON COUNTY, MS	HWY 22 / LAKESHIRE PKWY CAN	28089030400	1
217	-90.05656°	32.61002°	PEACE ST AND FULTON ST, MADISON COUNTY, MS	PEACE ST / FULTON ST CAN	28089030500	1
218	-89.84964°	32.59728°	NATCHEZ TRACE AND RATLIFF FERRY, MADISON COUNTY, MS	NATCHEZ TRACE / RATLIFF FERRY CAN	28089030900	1
219	-90.03639°	32.61137°	UNION ST AND W FULTON ST, MADISON COUNTY, MS	UNION ST / W FULTON ST CAN	28089030700	1
220	-90.03140°	32.62366°	DOBSON AVE AND SHERWOOD DR, MADISON COUNTY, MS	DOBSON AVE / SHERWOOD DR CAN	28089030600	1
221	-90.04207°	32.61504°	CANAL ST AND W NORTH ST, MADISON COUNTY, MS	CANAL ST / W NORTH ST CAN	28089030500	1
222	-89.83123°	32.67559°	LOTTVILLE RD AND JOHN DAY RD, MADISON COUNTY, MS	LOTTVILLE RD / JOHN DAY RD CAN	28089030900	1
223	-90.04634°	32.60637°	CAUTHEN ST AND ROSEBUD DR, MADISON COUNTY, MS	CAUTHEN ST / ROSEBUD DR CAN	28089030500	1
224	-90.03804°	32.53884°	N OLD CANTON RD AND COTTON BLOSSOM, MADISON COUNTY, MS	N OLD CANTON RD / COTTON BLOSSOM CAN	28089030400	1
225	-90.15770°	32.53746°	STRIBLING RD AND DEWEES, MADISON COUNTY, MS	STRIBLING RD / DEWEES CAN	28089030400	1
226	-90.04530°	32.60891°	W OTTO ST AND COWAN ST, MADISON COUNTY, MS	W OTTO ST / COWAN ST CAN	28089030500	1
227	-90.12356°	32.41132°	PEAR ORCHARD ROAD AND PEAR ORCHARD CIRCLE, MADISON COUNTY, MS	Pear Orchard Road/Pear Orchard Circle	28089030106	1
228	-89.76431°	32.68560°	HWY 16 EAST AND VIRGIN MARY RD, MADISON COUNTY, MS	HWY 16 EAST / VIRGIN MARY RD CAN	28089030900	1
229	-90.31272°	32.53870°	FIRST ST AND ODOM ST, MADISON COUNTY, MS	FIRST ST / ODOM ST CAN	28089030302	1
230	-89.90139°	32.61053°	RATLIFF FERRY RD AND LONE PINE R, MADISON COUNTY, MS	RATLIFF FERRY RD / LONE PINE R CAN	28089030900	1
231	-90.31288°	32.54216°	FIRST ST AND MAIN ST, MADISON COUNTY, MS	FIRST ST / MAIN ST FLO	28089030302	1
232	-90.02425°	32.62274°	GARFIELD ST AND LINCOLN ST, MADISON COUNTY, MS	GARFIELD ST / LINCOLN ST CAN	28089030600	1
233	-90.14138°	32.51689°	GLUCKSTADT RD AND C STORE, MADISON COUNTY, MS	GLUCKSTADT RD / C STORE CAN	28089030301	1
234	-90.13148°	32.39951°	EAST COUNTY LINE ROAD AND MOSSLINE DRIVE, MADISON COUNTY, MS	East County Line Road / Mossline Drive	28089030106	1
235	-90.00818°	32.61122°	HWY 16 AND HWY 43, MADISON COUNTY, MS	HWY 16 / HWY 43 CAN	28089030600	1

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236	-90.06335°	32.46814°	OLD RICE RD AND ASPEN DR, MADISON COUNTY, MS	OLD RICE RD / ASPEN DR CAN	28089030201	1
237	-90.11382°	32.41400°	711 LAKE HARBOUR DR, MADISON COUNTY, MS	711 LAKE HARBOUR DR RID	28089030106	1
238	-90.10624°	32.53152°	STRIBLING EXT AND CHURCH, MADISON COUNTY, MS	STRIBLING EXT / CHURCH CAN	28089030400	1
239	-90.31713°	32.58966°	HUNT AVE AND LIVINGSTON VERNON R, MADISON COUNTY, MS	HUNT AVE / LIVINGSTON VERNON R FLO	28089030302	1
240	-89.96975°	32.61860°	E HWY 16 AND ROBINSON RD, MADISON COUNTY, MS	E HWY 16 / ROBINSON RD CAN	28089030900	1
241	-89.75100°	32.76061°	HWY 43 AND MATLOCK RD, MADISON COUNTY, MS	HWY 43 / MATLOCK RD CAN	28089031000	1
242	-89.81078°	32.64797°	ROBINSON RD AND PAT LUCKETT RD, MADISON COUNTY, MS	ROBINSON RD / PAT LUCKETT RD CAN	28089030900	1
243	-90.17900°	32.47503°	N LIVINGSTON RD AND MCDONALD DR, MADISON COUNTY, MS	N LIVINGSTON RD / MCDONALD DR CAN	28089030302	1
244	-90.10638°	32.41625°	OLD CANTON RD AND MRA, MADISON COUNTY, MS	OLD CANTON RD / MRA MAD	28089030104	1
245	-90.05216°	32.62362°	1101 HOLMES AV, MADISON COUNTY, MS	1101 HOLMES AV CAN	28089030500	1
246	-90.10262°	32.40516°	875 WILLIAM BLVD, MADISON COUNTY, MS	875 WILLIAM BLVD RID	28089030108	1
247	-90.20374°	32.40357°	N LIVINGSTON RD AND MARY MYLES RD, MADISON COUNTY, MS	N LIVINGSTON RD / MARY MYLES RD RID	28089030206	1
248	-90.10138°	32.51712°	N. I-55 AND GLUCKSTADT ROAD, MADISON COUNTY, MS	N. I-55/Gluckstadt Road	28089030400	1
249	-90.05374°	32.61559°	112 SUNSET AVE, MADISON COUNTY, MS	112 SUNSET AVE CAN	28089030500	1
250	-90.00686°	32.67412°	HWY 51 AND PISGAH BOTTOM RD, MADISON COUNTY, MS	HWY 51 / PISGAH BOTTOM RD CAN	28089030900	1
251	-90.12696°	32.52344°	STILLHOUSE CREEK DR, MADISON COUNTY, MS	STILLHOUSE CREEK DR CAN	28089030400	1
252	-90.29964°	32.53531°	POCAHONTAS RD AND JEFFREYS RD, MADISON COUNTY, MS	POCAHONTAS RD / JEFFREYS RD FLO	28089030302	1
253	-90.08908°	32.56078°	OLD JACKSON RD AND RAGSDALE RD, MADISON COUNTY, MS	OLD JACKSON RD / RAGSDALE RD MAD	28089030400	1
254	-89.90813°	32.65834°	OLD HWY 16 AND CHURCH LN, MADISON COUNTY, MS	OLD HWY 16 / CHURCH LN CAN	28089030900	1
255	-90.02883°	32.51694°	YANDELL RD AND DEERFIELD BLVD, MADISON COUNTY, MS	YANDELL RD / DEERFIELD BLVD CAN	28089030400	1
256	-89.81422°	32.65004°	HHY 43 AND HWY 17, MADISON COUNTY, MS	HHY 43 / HWY 17 CAN	28089030900	1
257	-90.14667°	32.40387°	HWY 51 AND I-55, MADISON COUNTY, MS	HWY 51 / I-55 RID	28089030105	1
258	-90.10635°	32.42144°	OLD CANTON RD AND RICE RD, MADISON COUNTY, MS	OLD CANTON RD / RICE RD RID	28089030107	1
259	-90.19897°	32.42370°	N LIVINGSTON RD AND ROUSER RD, MADISON COUNTY, MS	N LIVINGSTON RD / ROUSER RD RID	28089030205	1
260	-90.05459°	32.64026°	GREEN ACRES AND KING RANCH, MADISON COUNTY, MS	GREEN ACRES / KING RANCH CAN	28089030500	1
261	-89.73869°	32.69439°	E HWY 16 AND PERMENTER RD, MADISON COUNTY, MS	E HWY 16 / PERMENTER RD CAN	28089030900	1
262	-90.00299°	32.61638°	COVINGTON DR AND HWY 43, MADISON COUNTY, MS	COVINGTON DR / HWY 43 CAN	28089030600	1
263	-90.03262°	32.63559°	W HWY 16 AND OIL MILL QUARTERS RD, MADISON COUNTY, MS	W HWY 16 / OIL MILL QUARTERS RD CAN	28089030600	1
264	-90.34346°	32.52296°	W HWY 22, MADISON COUNTY, MS	W HWY 22 CAN	28089030302	1
265	-90.03489°	32.61513°	HWY 51 AND N MAD, MADISON COUNTY, MS	HWY 51 / N MAD CAN	28089030600	1
266	-90.04753°	32.61673°	349 WELCH ST, MADISON COUNTY, MS	349 WELCH ST CAN	28089030500	1
267	-90.18817°	32.51525°	HWY 463 AND REUNION BLVD, MADISON COUNTY, MS	HWY 463 / REUNION BLVD MAD	28089030301	1
268	-90.14445°	32.51688°	GLUCKSTADT RD AND KRISTEN HILL RD, MADISON COUNTY, MS	GLUCKSTADT RD / KRISTEN HILL RD CAN	28089030400	1
269	-90.05065°	32.61748°	390 RICKS DR, MADISON COUNTY, MS	390 RICKS DR CAN	28089030500	1
270	-89.93042°	32.78058°	LORING RD AND TUCKER RD, MADISON COUNTY, MS	LORING RD / TUCKER RD CAN	28089031000	1
271	-90.03503°	32.63808°	CMUANDRAILROAD, MADISON COUNTY, MS	CMU/RAILROAD CAN	28089030600	1
272	-90.16140°	32.43008°	OLD AGENCY RD AND DINSMOR CRSG, MADISON COUNTY, MS	OLD AGENCY RD / DINSMOR CRSG RID	28089030206	1
273	-90.08551°	32.51169°	HWY 51 AND YANDELL RD, MADISON COUNTY, MS	HWY 51 / YANDELL RD CAN	28089030400	1
274	-90.04385°	32.61013°	W ACADEMY ST AND S WALNUT ST, MADISON COUNTY, MS	W ACADEMY ST / S WALNUT ST CAN	28089030500	1
275	-90.30622°	32.53867°	POCAHONTAS RD AND WATSON ST, MADISON COUNTY, MS	POCAHONTAS RD / WATSON ST CAN	28089030302	1
276	-90.05491°	32.47240°	OLD RICE RD AND MADI, MADISON COUNTY, MS	OLD RICE RD / MADI CAN	28089030201	1
277	-90.01125°	32.74899°	WAY RD AND GRAY CENTER RD, MADISON COUNTY, MS	WAY RD / GRAY CENTER RD CAN	28089031000	1
278	-90.08907°	32.56426°	OLD JACKSON RD AND HILL RD, MADISON COUNTY, MS	OLD JACKSON RD / HILL RD CAN	28089030400	1
279	-90.04050°	32.60405°	TROLIO ST AND W DINKINS ST, MADISON COUNTY, MS	TROLIO ST / W DINKINS ST CAN	28089030700	1
280	-90.31698°	32.58353°	KEARNEY PARK RD AND MRS ST, MADISON COUNTY, MS	KEARNEY PARK RD / MRS ST CAN	28089030302	1
281	-90.21386°	32.46539°	LAKE CAVALIER ROAD AND SUNSET LANE, MADISON COUNTY, MS	Lake Cavalier Road / Sunset lane	28089030302	1
282	-90.04239°	32.60974°	S CANAL ST AND APPT COMPLEX, MADISON COUNTY, MS	S CANAL ST / APPT COMPLEX CAN	28089030500	1

Compiled Unique Roadblocks

Point ID <i>rid</i>	Longitude <i>lon</i>	Latitude <i>lat</i>	Clean Address <i>clean_address</i>	Original Address <i>original_address</i>	Census Tract ID <i>geoid</i>	Number of Roadblocks <i>num_rbs</i>
283	-90.13632°	32.53750°	CATLETT RD AND STRIBLING RD, MADISON COUNTY, MS	CATLETT RD / STRIBLING RD CAN	28089030400	1
284	-90.26086°	32.49780°	ROBINSON SPRINGS RD AND ROBINSON, MADISON COUNTY, MS	ROBINSON SPRINGS RD / ROBINSON CAN	28089030302	1
285	-90.14391°	32.43605°	I-55 S AND RIDGELAND, MADISON COUNTY, MS	I-55 S / RIDGELAND CAN	28089030101	1
286	-90.04675°	32.61556°	BOYD ST, MADISON COUNTY, MS	Boyd St	28089030500	1
287	-90.08698°	32.41514°	BREAKERS LN, MADISON COUNTY, MS	BREAKERS LN CAN	28089030107	1
288	-90.04016°	32.49513°	TWELVE OAKS RD AND OLD CANTON RD, MADISON COUNTY, MS	TWELVE OAKS RD / OLD CANTON RD CAN	28089030201	1
289	-90.03969°	32.64034°	GREEN ACRES DR AND HWY 16W, MADISON COUNTY, MS	GREEN ACRES DR / HWY 16W CAN	28089030500	1
290	-90.13686°	32.54157°	TYLER LN AND CATLETT RD, MADISON COUNTY, MS	TYLER LN / CATLETT RD CAN	28089030400	1
291	-90.20355°	32.40807°	LIVINGSTON RD AND PEATRY PENDLETON, MADISON COUNTY, MS	LIVINGSTON RD / PEATRY PENDLETON RID	28089030206	1
292	-90.03133°	32.51693°	43 AND YANDELL RD, MADISON COUNTY, MS	43 / YANDELL RD CAN	28089030400	1
293	-90.05483°	32.61848°	KING RANCH RD AND GEORGE WASHINGTON AVE, MADISON COUNTY, MS	KING RANCH RD / GEORGE WASHINGTON AVE CAN	28089030500	1
294	-90.15555°	32.43023°	NATCHEZ TRACE AND GREENWOOD XING, MADISON COUNTY, MS	NATCHEZ TRACE / GREENWOOD XING RID	28089030206	1
295	-89.99463°	32.61118°	E HWY 16 AND COUNTRY CLUB DR, MADISON COUNTY, MS	E HWY 16 / COUNTRY CLUB DR CAN	28089030800	1
296	-89.93830°	32.78063°	LORING RD AND HARGON RD, MADISON COUNTY, MS	LORING RD / HARGON RD CAN	28089031000	1
297	-90.03336°	32.74445°	WAY RD AND WAY CIR, MADISON COUNTY, MS	WAY RD / WAY CIR CAN	28089031000	1
298	-90.10635°	32.43982°	RIDGECREST DR AND OLD CANTON RD, MADISON COUNTY, MS	RIDGECREST DR / OLD CANTON RD MAD	28089030101	1
299	-90.04935°	32.61853°	MACE STREET AND GEORGE WASHINGTON ST, MADISON COUNTY, MS	Mace Street / George Washington St	28089030500	1
300	-89.94203°	32.85523°	HWY 17 AND OLD 51 RD, MADISON COUNTY, MS	HWY 17 / OLD 51 RD PIC	28089031000	1
301	-90.11235°	32.40999°	NORTH PARK DR AND FONTAINE PL, MADISON COUNTY, MS	NORTH PARK DR / FONTAINE PL CAN	28089030106	1
302	-90.11094°	32.46031°	YANDELL AND MADISON CROSSING, MADISON COUNTY, MS	YANDELL / MADISON CROSSING CAN	28089030202	1
303	-90.14668°	32.53369°	SYCAMORE RIDGE AND ASHBROOKE BLV, MADISON COUNTY, MS	SYCAMORE RIDGE / ASHBROOKE BLV CAN	28089030400	1
304	-90.00198°	32.61001°	PEACE ST, MADISON COUNTY, MS	PEACE ST CAN	28089030600	1
305	-90.33811°	32.55318°	COX FERRY RD AND OLD HWY 49, MADISON COUNTY, MS	COX FERRY RD / OLD HWY 49 FLO	28089030302	1
306	-90.03286°	32.63661°	HWY 16 AND OIL MILL QUARTERS RD, MADISON COUNTY, MS	HWY 16 / OIL MILL QUARTERS RD CAN	28089030600	1
307	-90.31290°	32.54469°	FIRST ST AND CENTER ST, MADISON COUNTY, MS	FIRST ST / CENTER ST FLO	28089030302	1
308	-89.99718°	32.58401°	1528 HWY 43, MADISON COUNTY, MS	1528 HWY 43 CAN	28089030900	1
309	-90.04543°	32.61137°	ROBY ST AND W FULTON ST, MADISON COUNTY, MS	ROBY ST / W FULTON ST CAN	28089030500	1
310	-90.09464°	32.51365°	WEISENBERGER ROAD AND PARKWAY EAST, MADISON COUNTY, MS	Weisenberger Road / Parkway East	28089030204	1
311	-90.04283°	32.60405°	W DINKINS ST AND RANGE, MADISON COUNTY, MS	W DINKINS ST / RANGE CAN	28089030700	1
312	-90.05379°	32.62360°	HOLMES AVENUE AND WAYNE DRIVE, MADISON COUNTY, MS	Holmes Avenue/Wayne Drive	28089030500	1
313	-90.02437°	32.62048°	MILLER ST AND LINCOLN ST, MADISON COUNTY, MS	MILLER ST / LINCOLN ST CAN	28089030600	1
314	-89.79151°	32.75230°	HWY 43 AND HONEYSUCKER RD, MADISON COUNTY, MS	HWY 43 / HONEYSUCKER RD CAN	28089031000	1
315	-90.11850°	32.46476°	MADISON PARKWAY AND POST OAK RD, MADISON COUNTY, MS	MADISON PARKWAY / POST OAK RD MAD	28089030203	1
316	-90.09157°	32.49991°	1556 HWY 51, MADISON COUNTY, MS	1556 HWY 51 MAD	28089030201	1
317	-90.05488°	32.47242°	OLD RICE RD AND CHANNEL LN, MADISON COUNTY, MS	OLD RICE RD / CHANNEL LN MAD	28089030201	1
318	-90.31023°	32.54490°	111 KEARNEY PARK RD, MADISON COUNTY, MS	111 KEARNEY PARK RD FLO	28089030302	1
319	-90.05585°	32.47233°	OLD RICE AND HALEY CREEK, MADISON COUNTY, MS	OLD RICE / HALEY CREEK CAN	28089030201	1
320	-90.04889°	32.62275°	1006 HOLMES AV, MADISON COUNTY, MS	1006 HOLMES AV CAN	28089030500	1
321	-89.98647°	32.61325°	HWY 16 AND GREENFIELD DR, MADISON COUNTY, MS	HWY 16 / GREENFIELD DR CAN	28089030900	1
322	-90.10094°	32.48181°	HWY 51 AND TISDALE RD, MADISON COUNTY, MS	HWY 51 / TISDALE RD MAD	28089030203	1
323	-90.08110°	32.56065°	NISSAN AND I-55, MADISON COUNTY, MS	NISSAN / I-55 CAN	28089030400	1
324	-90.03939°	32.60659°	CAMERON ST AND LEE ST, MADISON COUNTY, MS	CAMERON ST / LEE ST CAN	28089030700	1
325	-90.09635°	32.42126°	RICE RD AND HARBOR DR, MADISON COUNTY, MS	RICE RD / HARBOR DR CAN	28089030107	1
326	-90.05480°	32.62393°	KING RANCH AND PARKVIEW, MADISON COUNTY, MS	KING RANCH / PARKVIEW CAN	28089030500	1
327	-90.07202°	32.46506°	HOY RD AND N OLD CANTON RD, MADISON COUNTY, MS	HOY RD / N OLD CANTON RD CAN	28089030201	1
328	-90.06374°	32.55366°	HIGHWAY 51 AND SOUTH LIBERTY, MADISON COUNTY, MS	Highway 51 / South Liberty	28089030400	1
329	-89.83846°	32.78040°	HWY 17 AND MCCARTY RD, MADISON COUNTY, MS	HWY 17 / MCCARTY RD CAM	28089031000	1

Compiled Unique Roadblocks

Point ID <i>rid</i>	Longitude <i>lon</i>	Latitude <i>lat</i>	Clean Address <i>clean_address</i>	Original Address <i>original_address</i>	Census Tract ID <i>geoid</i>	Number of Roadblocks <i>num_rbs</i>
330	-90.32426°	32.58968°	LIVINGSTON VERNON AND ST CHARLE, MADISON COUNTY, MS	LIVINGSTON VERNON / ST CHARLE CAN	28089030302	1
331	-90.31217°	32.55143°	KEARNEY PARK RD AND COURT ST, MADISON COUNTY, MS	KEARNEY PARK RD / COURT ST FLO	28089030302	1
332	-90.04385°	32.61134°	WALNUT ST AND W FULTON ST, MADISON COUNTY, MS	WALNUT ST / W FULTON ST CAN	28089030500	1
333	-89.87865°	32.62209°	ROBINSON RD AND PLEASANT GIFT RD, MADISON COUNTY, MS	ROBINSON RD / PLEASANT GIFT RD CAN	28089030900	1
334	-90.11325°	32.45780°	HWY 51 AND MADISON AVE, MADISON COUNTY, MS	HWY 51 / MADISON AVE CAN	28089030203	1
335	-90.10721°	32.46508°	HOY RD AND OLD CANTON RD, MADISON COUNTY, MS	HOY RD / OLD CANTON RD CAN	28089030202	1
336	-89.93550°	32.64578°	1400 SHARON RD, MADISON COUNTY, MS	1400 SHARON RD CAN	28089030900	1
337	-90.17773°	32.53680°	103 N I-55, MADISON COUNTY, MS	103 N I-55 RID	28089030400	1
338	-90.32935°	32.58968°	LIVINGSTON VERNON RD AND EMMIT R, MADISON COUNTY, MS	LIVINGSTON VERNON RD / EMMIT R CAN	28089030302	1
339	-89.98319°	32.65553°	GOODLOE RD . HWY 43, MADISON COUNTY, MS	GOODLOE RD . HWY 43 CAN	28089030900	1
340	-89.93564°	32.65857°	HWY 43 AND GOO, MADISON COUNTY, MS	HWY 43 / GOO CAN	28089030900	1
341	-90.13520°	32.54155°	TYLER LN AND CAT, MADISON COUNTY, MS	TYLER LN / CAT CAN	28089030400	1
342	-90.04442°	32.58665°	2941 HWY 51, MADISON COUNTY, MS	2941 HWY 51 CAN	28089030400	1
343	-90.08921°	32.53161°	CHURCH RD AND OLD JACKSON RD, MADISON COUNTY, MS	CHURCH RD / OLD JACKSON RD CAN	28089030400	1
344	-90.01306°	32.51686°	YANDELL RD AND BAINBRIDGE CROSSI, MADISON COUNTY, MS	YANDELL RD / BAINBRIDGE CROSSI MAD	28089030900	1
345	-90.11871°	32.46293°	MAIN ST AND POST OAK RD, MADISON COUNTY, MS	MAIN ST / POST OAK RD CAN	28089030203	1
346	-90.09119°	32.52016°	N INDUSTRIAL BLVD, MADISON COUNTY, MS	N INDUSTRIAL BLVD CAN	28089030400	1
347	-90.10640°	32.42712°	OLD CANTON RD AND NATCHEZ TRACE, MADISON COUNTY, MS	OLD CANTON RD / NATCHEZ TRACE RID	28089030101	1
348	-90.31714°	32.58966°	KEARNEY PARK AND LIVINGSTON VERNON, MADISON COUNTY, MS	KEARNEY PARK / LIVINGSTON VERNON CAN	28089030302	1
349	-90.15925°	32.68291°	HWY 22 AND PANTHER CREEK, MADISON COUNTY, MS	HWY 22 / PANTHER CREEK CAN	28089030400	1
350	-90.08528°	32.68191°	WILLIAMS BLVD, MADISON COUNTY, MS	WILLIAMS BLVD CAN	28089030400	1
351	-90.22227°	32.49411°	ROBINSON SPRING RD AND COKER RD, MADISON COUNTY, MS	ROBINSON SPRING RD / COKER RD CAN	28089030302	1
352	-90.10136°	32.40217°	PINE KNOLL CT, MADISON COUNTY, MS	PINE KNOLL CT RID	28089030108	1
353	-90.01058°	32.61731°	COVINGTON DRIVE AND CISNE AVE, MADISON COUNTY, MS	Covington Drive / Cisne Ave	28089030600	1
354	-90.04671°	32.61298°	108 BOYD STREET, MADISON COUNTY, MS	108 Boyd Street	28089030500	1
355	-89.96806°	32.64185°	HWY 43 AND QUAIL RD, MADISON COUNTY, MS	HWY 43 / QUAIL RD CAN	28089030900	1
356	-90.09279°	32.49762°	HWY 51 AND GROSS RD, MADISON COUNTY, MS	HWY 51 / GROSS RD MAD	28089030204	1
357	-90.30010°	32.56464°	HARRIS RD AND HARRIS SUBDIVISION, MADISON COUNTY, MS	HARRIS RD / HARRIS SUBDIVISION FLO	28089030302	1
358	-90.07841°	32.60265°	HWY 22 AND VIRLILIA RD, MADISON COUNTY, MS	HWY 22 / VIRLILIA RD CAN	28089030400	1
359	-90.17763°	32.42745°	OLD AGENCY RD AND PATTERSON, MADISON COUNTY, MS	OLD AGENCY RD / PATTERSON CAN	28089030205	1
360	-89.93050°	32.65864°	OLD HWY 16 AND ROBERT DEARON RD, MADISON COUNTY, MS	OLD HWY 16 / ROBERT DEARON RD CAN	28089030900	1
361	-90.03488°	32.61856°	UNION ST AND LIBERTY ST, MADISON COUNTY, MS	UNION ST / LIBERTY ST CAN	28089030600	1

Source: Funderburk Report, Appendix D

Appendix D1

Near Analysis

Census Tract ID within 20 Meters of the Road Block	Census Tract ID Assigned by Dr. Ricchetti	Point ID	Longitude	Latitude	Number of Roadblocks	Near Distance (Meters) ^[1]	Near Rank ^[2]	Percent Black Population for Census Tract Assigned by Dr. Ricchetti	Percent Black Population for Census Tract within 20 Meters of the Road Block	Max Percent Black Population of All Tracts within 20 Meters of the Road Block	Min Percent Black Population of All Tracts within 20 Meters of the Road Block	Could be More Black ^[3] could_be moreblack	Could be Less Black ^[4] could_be lessblack	Number of Roadblocks Could be More Black ^[5] num_rbs_could be_more_black	Number of Roadblocks Could be Less Black ^[6] num_rbs_could be_less_black
<i>near_geoid</i>	<i>rb_geoid</i>	<i>rid</i>	<i>lon</i>	<i>lat</i>	<i>num_rbs</i>	<i>NEAR_DIST</i>	<i>NEAR_RANK</i>	<i>rb_pctblack</i>	<i>near_pctblack</i>	<i>max_pctblack</i>	<i>min_pctblack</i>				
28089030101	28089030101	141	-90.12996°	32.42631°	2	0.00	1	10.7%	10.7%	46.2%	10.7%	1	0	2	0
28089030101	28089030101	194	-90.11701°	32.45051°	1	0.00	1	10.7%	10.7%	11.6%	10.7%	1	0	1	0
28089030101	28089030101	347	-90.10640°	32.42712°	1	0.00	1	10.7%	10.7%	18.0%	10.7%	1	0	1	0
28089030101	28089030101	188	-90.10644°	32.45044°	1	0.00	1	10.7%	10.7%	10.9%	10.7%	1	0	1	0
28089030104	28089030104	77	-90.10902°	32.41405°	5	0.00	1	16.5%	16.5%	47.6%	16.5%	1	0	5	0
28089030104	28089030104	67	-90.12352°	32.42500°	6	0.00	1	16.5%	16.5%	46.2%	16.5%	1	0	6	0
28089030104	28089030104	244	-90.10638°	32.41625°	1	0.00	1	16.5%	16.5%	18.0%	16.5%	1	0	1	0
28089030105	28089030105	59	-90.14375°	32.42818°	7	0.00	1	46.2%	46.2%	46.2%	10.7%	0	1	0	7
28089030106	28089030106	237	-90.11382°	32.41400°	1	0.00	1	47.6%	47.6%	47.6%	16.5%	0	1	0	1
28089030106	28089030106	4	-90.10804°	32.40255°	59	0.00	1	47.6%	47.6%	65.6%	47.6%	1	0	59	0
28089030106	28089030106	20	-90.10651°	32.40515°	19	0.00	1	47.6%	47.6%	65.6%	47.6%	1	0	19	0
28089030106	28089030106	234	-90.13148°	32.39951°	1	0.00	1	47.6%	47.6%	47.6%	47.6%	0	0	0	0
28089030106	28089030106	25	-90.13207°	32.40682°	17	0.00	1	47.6%	47.6%	47.6%	46.2%	0	1	0	17
28089030106	28089030106	22	-90.10635°	32.41099°	18	0.00	1	47.6%	47.6%	65.6%	47.6%	1	0	18	0
28089030107	28089030107	3	-90.08861°	32.41169°	65	0.53	2	18.0%	18.0%	65.6%	18.0%	1	0	65	0
28089030107	28089030107	18	-90.09314°	32.41200°	20	0.00	1	18.0%	18.0%	65.6%	18.0%	1	0	20	0
28089030107	28089030107	258	-90.10635°	32.42144°	1	0.00	1	18.0%	18.0%	18.0%	16.5%	0	1	0	1
28089030108	28089030108	110	-90.10625°	32.41099°	4	0.00	1	65.6%	65.6%	65.6%	47.6%	0	1	0	4
28089030108	28089030108	53	-90.08884°	32.41167°	8	0.00	1	65.6%	65.6%	65.6%	18.0%	0	1	0	8
28089030201	28089030201	14	-89.97501°	32.52461°	25	0.00	1	18.6%	18.6%	69.5%	18.6%	1	0	25	0
28089030201	28089030201	203	-89.97251°	32.52276°	1	0.00	1	18.6%	18.6%	69.5%	18.6%	1	0	1	0
28089030201	28089030201	49	-89.97754°	32.52706°	9	0.00	1	18.6%	18.6%	69.5%	18.6%	1	0	9	0
28089030201	28089030201	316	-90.09157°	32.49991°	1	0.00	1	18.6%	18.6%	18.6%	14.7%	0	1	0	1
28089030201	28089030201	51	-89.99343°	32.51694°	8	0.00	1	18.6%	18.6%	69.5%	18.6%	1	0	8	0
28089030202	28089030202	113	-90.09117°	32.46505°	3	0.00	1	10.9%	10.9%	18.6%	10.9%	1	0	3	0
28089030203	28089030203	334	-90.11325°	32.45780°	1	0.00	1	11.6%	11.6%	11.6%	10.9%	0	1	0	1
28089030203	28089030203	122	-90.10952°	32.46509°	3	0.36	2	11.6%	11.6%	11.6%	10.9%	0	1	0	3
28089030203	28089030203	322	-90.10094°	32.48181°	1	0.00	1	11.6%	11.6%	18.6%	11.6%	1	0	1	0
28089030204	28089030204	108	-90.09547°	32.49241°	4	0.31	2	14.7%	14.7%	18.6%	14.7%	1	0	4	0
28089030204	28089030204	17	-90.17293°	32.45587°	21	0.00	1	14.7%	14.7%	17.9%	14.7%	1	0	21	0
28089030204	28089030204	356	-90.09279°	32.49762°	1	0.00	1	14.7%	14.7%	18.6%	14.7%	1	0	1	0
28089030205	28089030205	359	-90.17763°	32.42745°	1	0.00	1	17.9%	17.9%	17.9%	13.0%	0	1	0	1
28089030205	28089030205	259	-90.19897°	32.42370°	1	0.00	1	17.9%	17.9%	49.3%	13.0%	1	1	1	1
28089030206	28089030206	139	-90.20283°	32.40014°	2	0.69	1	13.0%	13.0%	13.0%	13.0%	0	0	0	0
28089030206	28089030206	39	-90.17659°	32.40026°	11	0.00	1	13.0%	13.0%	46.2%	13.0%	1	0	11	0
28089030206	28089030206	37	-90.19989°	32.42081°	11	0.00	1	13.0%	13.0%	17.9%	13.0%	1	0	11	0
28089030206	28089030206	101	-90.18200°	32.40020°	4	0.37	1	13.0%	13.0%	13.0%	13.0%	0	0	0	0
28089030206	28089030206	154	-90.19946°	32.42228°	2	0.00	1	13.0%	13.0%	17.9%	13.0%	1	0	2	0
28089030206	28089030206	1	-90.17706°	32.40025°	114	0.00	1	13.0%	13.0%	13.0%	13.0%	0	0	0	0
28089030301	28089030301	80	-90.15769°	32.51791°	5	0.00	1	11.6%	11.6%	28.0%	11.6%	1	0	5	0
28089030301	28089030301	33	-90.19194°	32.52423°	12	0.00	1	11.6%	11.6%	28.0%	11.6%	1	0	12	0
28089030301	28089030301	233	-90.14138°	32.51689°	1	0.00	1	11.6%	11.6%	28.0%	11.6%	1	0	1	0
28089030301	28089030301	177	-90.13915°	32.49762°	2	0.00	1	11.6%	11.6%	14.7%	11.6%	1	0	2	0
28089030301	28089030301	196	-90.16147°	32.51903°	1	0.00	1	11.6%	11.6%	28.0%	11.6%	1	0	1	0
28089030302	28089030302	189	-90.19880°	32.43164°	1	0.00	1	49.3%	49.3%	49.3%	17.9%	0	1	0	1
28089030302	28089030302	118	-90.20074°	32.48393°	3	0.00	1	49.3%	49.3%	49.3%	11.6%	0	1	0	3
28089030302	28089030302	50	-90.24606°	32.56062°	8	0.25	2	49.3%	49.3%	49.3%	28.0%	0	1	0	8
28089030302	28089030302	43	-90.18657°	32.45495°	10	0.00	1	49.3%	49.3%	49.3%	14.7%	0	1	0	10
28089030302	28089030302	243	-90.17900°	32.47503°	1	0.00	1	49.3%	49.3%	49.3%	14.7%	0	1	0	1
28089030302	28089030302	64	-90.20086°	32.44432°	7	0.00	1	49.3%	49.3%	49.3%	17.9%	0	1	0	7
28089030400	28089030400	100	-90.07054°	32.51711°	4	0.00	1	28.0%	28.0%	28.0%	18.6%	0	1	0	4
28089030400	28089030400	127	-90.07056°	32.51712°	3	0.00	1	28.0%	28.0%	28.0%	18.6%	0	1	0	3
28089030400	28089030400	248	-90.10138°	32.51712°	1	0.00	1	28.0%	28.0%	28.0%	14.7%	0	1	0	1
28089030400	28089030400	151	-90.07205°	32.51708°	2	0.09	2	28.0%	28.0%	28.0%	18.6%	0	1	0	2

Near Analysis

Census Tract ID within 20 Meters of the Road Block	Census Tract ID Assigned by Dr. Ricchetti	Point ID	Longitude	Latitude	Number of Roadblocks	Near Distance (Meters) ^[1]	Near Rank ^[2]	Percent Black Population for Census Tract Assigned by Dr. Ricchetti	Percent Black Population for Census Tract within 20 Meters of the Road Block	Max Percent Black Population of All Tracts within 20 Meters of the Road Block	Min Percent Black Population of All Tracts within 20 Meters of the Road Block	Could be More Black ^[3] could_be moreblack	Could be Less Black ^[4] could_be lessblack	Number of Roadblocks Could be More Black ^[5] num_rbs_could be_more_black	Number of Roadblocks Could be Less Black ^[6] num_rbs_could be_less_black
<i>near_geoid</i>	<i>rb_geoid</i>	<i>rid</i>	<i>lon</i>	<i>lat</i>	<i>num_rbs</i>	<i>NEAR_DIST</i>	<i>NEAR_RANK</i>	<i>rb_pctblack</i>	<i>near_pctblack</i>	<i>max_pctblack</i>	<i>min_pctblack</i>				
28089030400	28089030400	268	-90.14445°	32.51688°	1	0.47	2	28.0%	28.0%	28.0%	11.6%	0	1	0	1
28089030400	28089030400	273	-90.08551°	32.51169°	1	0.07	2	28.0%	28.0%	28.0%	14.7%	0	1	0	1
28089030400	28089030400	98	-90.07178°	32.51710°	4	0.00	1	28.0%	28.0%	28.0%	18.6%	0	1	0	4
28089030400	28089030400	255	-90.02883°	32.51694°	1	0.16	2	28.0%	28.0%	28.0%	18.6%	0	1	0	1
28089030400	28089030400	161	-90.07616°	32.51581°	2	0.00	1	28.0%	28.0%	28.0%	18.6%	0	1	0	2
28089030400	28089030400	89	-90.13200°	32.51692°	4	0.00	1	28.0%	28.0%	28.0%	11.6%	0	1	0	4
28089030400	28089030400	292	-90.03133°	32.51693°	1	0.00	1	28.0%	28.0%	28.0%	18.6%	0	1	0	1
28089030500	28089030500	211	-90.05476°	32.63267°	1	0.00	1	89.5%	89.5%	89.5%	28.0%	0	1	0	1
28089030500	28089030500	289	-90.03969°	32.64034°	1	0.00	1	89.5%	89.5%	89.5%	28.0%	0	1	0	1
28089030500	28089030500	260	-90.05459°	32.64026°	1	0.00	1	89.5%	89.5%	89.5%	28.0%	0	1	0	1
28089030500	28089030500	72	-90.03845°	32.62370°	6	0.00	1	89.5%	89.5%	89.5%	83.7%	0	1	0	6
28089030500	28089030500	11	-90.03488°	32.64034°	32	0.00	1	89.5%	89.5%	89.5%	28.0%	0	1	0	32
28089030600	28089030600	157	-89.96033°	32.62167°	2	0.00	1	83.7%	83.7%	83.7%	69.5%	0	1	0	2
28089030600	28089030600	304	-90.00198°	32.61001°	1	0.00	1	83.7%	83.7%	83.7%	59.6%	0	1	0	1
28089030600	28089030600	235	-90.00818°	32.61122°	1	0.14	2	83.7%	83.7%	83.7%	59.6%	0	1	0	1
28089030600	28089030600	8	-90.03373°	32.64035°	38	0.00	1	83.7%	83.7%	83.7%	69.5%	0	1	0	38
28089030600	28089030600	115	-90.01183°	32.63320°	3	0.00	1	83.7%	83.7%	83.7%	69.5%	0	1	0	3
28089030600	28089030600	271	-90.03503°	32.63808°	1	0.00	1	83.7%	83.7%	89.5%	83.7%	1	0	1	0
28089030600	28089030600	19	-89.98714°	32.61306°	19	0.57	2	83.7%	83.7%	83.7%	59.6%	0	1	0	19
28089030700	28089030700	166	-90.03491°	32.60404°	2	0.00	1	58.4%	58.4%	59.6%	58.4%	1	0	2	0
28089030800	28089030800	295	-89.99463°	32.61118°	1	0.00	1	59.6%	59.6%	83.7%	59.6%	1	0	1	0
28089030800	28089030800	158	-90.02995°	32.61016°	2	0.00	1	59.6%	59.6%	59.6%	58.4%	0	1	0	2
28089030900	28089030900	321	-89.98647°	32.61325°	1	0.00	1	69.5%	69.5%	83.7%	59.6%	1	1	1	1
28089030900	28089030900	107	-89.76596°	32.74020°	4	0.00	1	69.5%	69.5%	84.0%	69.5%	1	0	4	0
28089030900	28089030900	240	-89.96975°	32.61860°	1	0.00	1	69.5%	69.5%	83.7%	69.5%	1	0	1	0
28089030900	28089030900	124	-89.96964°	32.52200°	3	0.00	1	69.5%	69.5%	69.5%	18.6%	0	1	0	3
28089030900	28089030900	344	-90.01306°	32.51686°	1	0.00	1	69.5%	69.5%	69.5%	18.6%	0	1	0	1
28089031000	28089031000	85	-89.80946°	32.71561°	5	0.00	1	84.0%	84.0%	84.0%	69.5%	0	1	0	5

Source: Funderburk Report, Appendix D; Mississippi Transverse Mercator NAD83 Projection; Madison County Census Tract Polygon Data

Note:

[1] The distance in meters returned by the Near Analysis between the road block point and the nearest boundary of the Census Tract D referenced by the "Census Tract D within 20 Meters of the Road Block." This value is between zero (indicating the point is in the poly) and 20 meters.

[2] If more than one Census Tract is within 20 meters of the road block point, the rank indicates the order in which they are closest (the closest being 1).

[3] A value of 1 if the "Percent Black Population for Census Tract Assigned by Dr. Ricchetti" is less than the "Max Percent Black Population of All Tracts within 20 Meters of the Road Block."

[4] A value of 1 if the "Percent Black Population for Census Tract Assigned by Dr. Ricchetti" is more than the "Min Percent Black Population of All Tracts within 20 Meters of the Road Block."

[5] The "Number of Roadblocks" times the value of "Could be More Black."

[6] The "Number of Roadblocks" times the value of "Could be Less Black."

Appendix D2

Near Analysis

Point ID <i>rid</i>	Clean Address <i>clean_addr</i>
141	HWY 51 AND NATCHEZ TRACE, MADISON COUNTY, MS
194	HWY 51 AND ST AUGUSTINE DR, MADISON COUNTY, MS
347	OLD CANTON RD AND NATCHEZ TRACE, MADISON COUNTY, MS
188	OLD CANTON RD AND ST AUGUSTINE D, MADISON COUNTY, MS
77	LAKE HARBOUR DRIVE AND RANKIN, MADISON COUNTY, MS
67	RICE RD AND PEAR ORCHARD RD, MADISON COUNTY, MS
244	OLD CANTON RD AND MRA, MADISON COUNTY, MS
59	NATCHEZ TRACE PKWY AND I-55, MADISON COUNTY, MS
237	711 LAKE HARBOUR DR, MADISON COUNTY, MS
4	OLD CANTON RD AND PINE KNOLL DR, MADISON COUNTY, MS
20	OLD CANTON RD AND WILLIAM BLVD, MADISON COUNTY, MS
234	EAST COUNTY LINE ROAD AND MOSSLINE DRIVE, MADISON COUNTY, MS
25	TOWNE CENTER AND WHEATLEY, MADISON COUNTY, MS
22	HARBOUR PT XING AND OLD CANTON, MADISON COUNTY, MS
3	LOWER SPILLWAY RD, MADISON COUNTY, MS
18	HARBOR AND LAKE HARBOR, MADISON COUNTY, MS
258	OLD CANTON RD AND RICE RD, MADISON COUNTY, MS
110	HARBOUR POINTE CROSSING AND NORT, MADISON COUNTY, MS
53	SPILLWAY RD AND BREAKERS LN, MADISON COUNTY, MS
14	HWY 43 AND NATCHEZ TRACE PKWY, MADISON COUNTY, MS
203	HWY 43 AND BROWNS LANDING RD, MADISON COUNTY, MS
49	HWY 43 AND YANDELL RD, MADISON COUNTY, MS
316	1556 HWY 51, MADISON COUNTY, MS
51	YANDELL RD AND TWELVE OAKS TRACE, MADISON COUNTY, MS
113	HOY RD AND RICE RD, MADISON COUNTY, MS
334	HWY 51 AND MADISON AVE, MADISON COUNTY, MS
122	HWY 463 AND MADISON MIDDLE, MADISON COUNTY, MS
322	HWY 51 AND TISDALE RD, MADISON COUNTY, MS
108	HWY 51 AND GREEN OAK LN, MADISON COUNTY, MS
17	LAKE CASTLE RD AND RICHARDSON RD, MADISON COUNTY, MS
356	HWY 51 AND GROSS RD, MADISON COUNTY, MS
359	OLD AGENCY RD AND PATTERSON, MADISON COUNTY, MS
259	N LIVINGSTON RD AND ROUSER RD, MADISON COUNTY, MS
139	N LIVINGSTON RD AND COUNTY LINE, MADISON COUNTY, MS
39	I-220 AND W COUNTY LINE RD, MADISON COUNTY, MS
37	LIVINGSTON RD AND OLD AGENCY RD, MADISON COUNTY, MS
101	W COUNTY LINE AND HIGHLAND COLONY, MADISON COUNTY, MS
154	N LIVINGSTON RD AND NATCHEZ TRACE BRIDGE, MADISON COUNTY, MS
1	W COUNTY LINE RD AND I-220, MADISON COUNTY, MS
80	GLUCKSTADT RD AND DEWEES RD, MADISON COUNTY, MS
33	HWY 463 AND GLUCKSTADT RD, MADISON COUNTY, MS
233	GLUCKSTADT RD AND C STORE, MADISON COUNTY, MS
177	BOZEMAN RD AND REUNION ANNANDALE, MADISON COUNTY, MS
196	463 AND GLUCKSTADT RD, MADISON COUNTY, MS
189	N LIVINGSTON RD AND COU, MADISON COUNTY, MS
118	ROBINSON SPRINGS RD AND POC, MADISON COUNTY, MS
50	LIVINGSTON VERNON RD AND STOKES, MADISON COUNTY, MS
43	N LIVINGSTON RD AND LAKE CASTLE RD, MADISON COUNTY, MS
243	N LIVINGSTON RD AND MCDONALD DR, MADISON COUNTY, MS

Near Analysis

Point ID <i>rid</i>	Clean Address <i>clean_addr</i>
64	LAKE CAVALIER RD AND N LIVINGSTO, MADISON COUNTY, MS
100	YANDELL RD AND MADISON CROSSING, MADISON COUNTY, MS
127	300 YANDELL RD, MADISON COUNTY, MS
248	N. I-55 AND GLUCKSTADT ROAD, MADISON COUNTY, MS
151	YANDELL RD AND BRACEY RD, MADISON COUNTY, MS
268	GLUCKSTADT RD AND KRISTEN HILL RD, MADISON COUNTY, MS
273	HWY 51 AND YANDELL RD, MADISON COUNTY, MS
98	YANDELL RD AND CLARKDELL RD, MADISON COUNTY, MS
255	YANDELL RD AND DEERFIELD BLVD, MADISON COUNTY, MS
161	YANDELL RD AND CLARKDELL RD EXT, MADISON COUNTY, MS
89	GLUCKSTADT RD AND CATLETT RD, MADISON COUNTY, MS
292	43 AND YANDELL RD, MADISON COUNTY, MS
211	HEINDL RD AND KING RANCH RD, MADISON COUNTY, MS
289	GREEN ACRES DR AND HWY 16W, MADISON COUNTY, MS
260	GREEN ACRES AND KING RANCH, MADISON COUNTY, MS
72	RAILROAD ST AND MARTIN LUTHER KI, MADISON COUNTY, MS
11	GREEN ACRES AND RAILROAD ST, MADISON COUNTY, MS
157	E HWY 16 AND ROYAL OAK RD, MADISON COUNTY, MS
304	PEACE ST, MADISON COUNTY, MS
235	HWY 16 AND HWY 43, MADISON COUNTY, MS
8	W HWY 16 AND GREEN ACRES, MADISON COUNTY, MS
115	FINNEY RD AND MORGAN RD, MADISON COUNTY, MS
271	CMUANDRAILROAD, MADISON COUNTY, MS
19	HWY 16 AND AVONDALE RD, MADISON COUNTY, MS
166	S LIBERTY ST AND W DINKINS ST, MADISON COUNTY, MS
295	E HWY 16 AND COUNTRY CLUB DR, MADISON COUNTY, MS
158	ACADEMY ST AND LYON ST, MADISON COUNTY, MS
321	HWY 16 AND GREENFIELD DR, MADISON COUNTY, MS
107	SULPHUR SPRING RD AND GIN RD, MADISON COUNTY, MS
240	E HWY 16 AND ROBINSON RD, MADISON COUNTY, MS
124	HWY 43 AND TURCOTTE LAB DR, MADISON COUNTY, MS
344	YANDELL RD AND BAINBRIDGE CROSSI, MADISON COUNTY, MS
85	HWY 17 AND SULPHUR SPRINGS RD, MADISON COUNTY, MS

Source: Funderburk Report, Appendix D; Mississippi Transverse Mercator NAD83 Projection; Madison County Census Tract Polygons Data

EXHIBIT 4

**UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
JACKSON DIVISION**

LATOYA BROWN; LAWRENCE
BLACKMON; HERBERT ANTHONY
GREEN; KHADAFY MANNING;
QUINNETTA MANNING; MARVIN
MCFIELD; NICHOLAS SINGLETON;
STEVEN SMITH; BESSIE THOMAS;
and
BETTY JEAN WILLIAMS TUCKER,
individually and on behalf of a class of all
others similarly situated,

Plaintiffs,

v.

MADISON COUNTY, MISSISSIPPI;
SHERIFF RANDALL S. TUCKER, in his
official capacity; and MADISON
COUNTY
SHERIFF'S DEPUTIES JOHN DOES #1
through #6, in their individual capacities,

Defendants.

Civil Action No.

3:17-cv-00347-WHB-LRA

REBUTTAL EXPERT REPORT OF JUSTIN MCCRARY, Ph.D.

July 2, 2018

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1. QUALIFICATIONS AND ASSIGNMENT

1.1. *Qualifications*

1. I am an economist with expertise in economic modeling, statistical methods, and law and economics, among other subjects. I received my A.B. in Public Policy from Princeton University in 1996. After working at National Economics Research Associates in White Plains, New York, and the Federal Reserve Bank of New York from 1996 to 1998, I began my Ph.D. in Economics at the University of California, Berkeley (“Berkeley”), completing the degree in June 2003. After close to five years as Assistant Professor at the University of Michigan (“Michigan”), I became Assistant Professor of Law at Berkeley in January 2008 and was promoted to Professor in July 2010, a position I hold today. While at Berkeley, I have taught courses on introductory, intermediate, and advanced statistics to J.D., L.L.M., and Ph.D. students; on law and economics to J.D. students as well as undergraduates; on labor economics to Ph.D. students in economics and in other fields; and on business law to J.D., L.L.M., and M.B.A. students. In Fall 2017, I took leave from Berkeley and assumed a position as the Samuel Rubin Visiting Professor of Law at the law school of Columbia University (“Columbia”), and effective July 2018, I will join the Columbia law faculty on a permanent basis as the Paul J. Evanson Professor of law. At Columbia, I will teach corporations, antitrust, economics, and statistics.
2. While at Berkeley, I served as the Founding Director of D-Lab, the Social Sciences Data Laboratory at Berkeley, from July 2014 to June 2017, at which point I stepped down to visit Columbia. D-Lab trains graduate students in statistical and data science techniques relevant to modern computation and modern data collections. In addition, the D-Lab archives major data collections, such as those associated with the Census Research Data Centers, the financial market, birth certificate data, and other large-scale collections of import. At D-Lab, I lectured and advised graduate students and faculty regarding high-performance and high-throughput computing, statistical software, and statistical and econometric techniques, including methods for inferring causality from observational data.
3. From September 2009 until July 2014, when I began to direct the D-Lab, I co-directed the Law and Economics Program at Berkeley Law. Since 2017, I have been a member of the Board of Directors of the American Law and Economics Association.

4. Since 2008, I have co-directed the Economics of Crime Working Group of the National Bureau of Economic Research (“NBER”). The NBER is the preeminent professional association of economists in the world, with over 1,400 members worldwide. I was invited to become a Faculty Research Fellow of the NBER in 2006 and remained in that position until 2012, when I was invited to become a Faculty Research Associate, a position I hold today. In my role as co-Director of the Economics of Crime Working Group, I annually review emerging research on criminal enterprises, deterrence theory, and related issues, selecting the best papers on the subject for presentation at conference, and I propose younger scholars for entry to the NBER.
5. As noted, I previously worked at Michigan. From 2003 through 2007, I was Assistant Professor of Public Policy and Assistant Professor of Economics. While at Michigan, I taught introductory statistics and advanced microeconomic theory to M.P.P. students, and advanced econometric theory to Ph.D. students.
6. My research spans a diverse range of topics, including econometric and statistical methodology, crime, employment discrimination, income inequality, education, antitrust, fertility, financial markets, and monetary policy. I have published 18 papers, many of them in leading journals within economics, such as the *American Economic Review*, the *Review of Economics and Statistics*, the *Journal of Economic Literature*, and the *Journal of Econometrics*. According to Google Scholar, six of my papers have been cited over 100 times in the academic literature, with one of those papers, entitled “Manipulation of the Running Variable in the Regression Discontinuity Design” and published in the *Journal of Econometrics*, having been cited over 2,000 times. In addition to my published papers, I am a co-editor of the book *Controlling Crime: Strategies and Tradeoffs*, published by the University of Chicago Press.
7. Over the years, my research has been supported by Michigan, Berkeley, the MacArthur Foundation, the NBER, the National Institutes of Health, the National Science Foundation, the Arnold Foundation, the Spencer Foundation, and the Robert Wood Johnson Foundation.
8. I regularly review articles for the leading peer reviewed journals within economics, including *Econometrica*, the *American Economic Review*, the *Quarterly Journal of Economics*, the *Journal of Political Economy*, the *Review of Economic Studies*, the *Journal of Econometrics*, the *Review of Economics and Statistics*, and the *American*

Law and Economics Review. Peer review specifically focuses on assessing whether submitted manuscripts are employing methodologies that are consistent with academic standards.

9. My consulting experience spans a wide range of industries and markets. For example, I have previously analyzed the extent to which alleged collusive behavior among health care providers affected prices; the extent of infringing sales in a patent lawsuit pertaining to pharmaceuticals; the potential anti-competitive implications of a proposed telecommunications merger; damages associated with an alleged price-fixing conspiracy in the corrugated packaging industry; damages associated with an alleged price-fixing conspiracy in several prominent high-technology product markets; and damages associated with an alleged price-fixing conspiracy in the sale of retail gasoline.
10. In addition to work as a consultant for companies, I often provide consulting for state, local, and federal government, frequently on a *pro bono* basis. Many of these engagements revolve around quantifying the benefits of safety investments, or the extent of differences between racial or ethnic groups, such as differences in income, employment, or arrest rates. All of these engagements have involved the study and use of economics, econometrics, and statistics.
11. Finally, I am frequently invited to give talks regarding the utilization of statistical methodologies in empirical legal studies and from 2011–2015 gave day-long lectures for the annual *Causal Inference Workshop*, as well as its more advanced version, the *Advanced Causal Inference Workshop*. This Spring, I will again participate in the *Causal Inference Workshop*.
12. A copy of my curriculum vitae, including a list of previous testimony and depositions, is included as Appendix A. I am doing this work on a *pro bono* basis. I have been assisted in this matter by staff of Cornerstone Research, who worked under my direction.

1.2. Assignment

13. I have been asked by counsel for Plaintiffs to review the reports of Dr. Steward and Dr. Ricchetti, and comment on Dr. Steward's claim that Dr. Ricchetti's methodology is not a widely-accepted methodology in the academic literature on the economics of crime.

14. As part of my own academic research, I am the co-Director of the Economics of Crime Working Group for the National Bureau of Economic Research, where I annually review emerging empirical research on crime, economics, and related issues, selecting the best papers on the subject for presentation at conference, and I propose younger scholars for entry to the NBER. I have also written extensively on the economics of crime and the statistical methodologies used to analyze the relationship between crime and other factors, including a recently published paper that is the lead article in the *Journal of Economic Literature* summarizing numerous papers that use statistical methods to explore a variety of questions related to crime. I have also written extensively on statistical methods used to analyze outcomes across race. Thus, I have in-depth expertise on the methodologies used in this field.
15. As I explain below, the methods Dr. Ricchetti uses are widely accepted in the academic literature and by Courts. Dr. Steward's claims about the literature are misleading, inaccurate, and reveal a misunderstanding of standard methodological issues.

2. USING GEOGRAPHIC DATA TO TEST HOW OUTCOMES VARY BY RACE ACROSS DIFFERENT NEIGHBORHOODS IS WIDELY ACCEPTED IN THE ACADEMIC LITERATURE AND BY COURTS

16. Dr. Ricchetti's report uses a regression methodology that is standard in the academic literature. Specifically, Dr. Ricchetti analyzes how roadblock frequency varies in neighborhoods of differing racial composition, while controlling for DUI and traffic citations of drivers in each area. As I explain below, this type of regression analysis – in which a researcher analyzes differences in outcomes across geographic areas to understand how different demographic and economic factors affect those outcomes – is one of the most widely used research methods in economics and statistics.
17. Despite the fact that Dr. Ricchetti uses such a standard and widely-accepted methodological approach, Dr. Steward asserts that Dr. Ricchetti's methodology is inconsistent with the academic literature and not reliable. As I explain below, Dr. Steward's assertions misunderstand basic econometric principles and misrepresent the academic literature. Dr. Steward's claims can be organized into two categories, which I address in turn below.

2.1. Dr. Steward appears to misunderstand the purpose of Dr. Ricchetti's measure of race, and mischaracterizes his methodology

18. First, Dr. Steward argues that Dr. Ricchetti's use of the share of population that is African-American in a given census tract is not reliable because the share of population in a community that is African-American is not a reliable measure of the share of drivers in a community who are African-American.¹ While I agree with Dr. Steward that controlling for driving behavior is important in an analysis of

¹ Rebuttal Expert Report of Dwight D. Steward, Ph.D. RE: Bryan Ricchetti, Ph.D., May 8, 2018 ("Steward Report"), ¶¶ 39–40 ("[I]t is generally acknowledged in the police racial profiling research literature that the residential population in a given area is not an appropriate measure of the driving population in these types of settings. Further, these studies generally do not indicate that police racial profiling bias can be expected to occur at some specific racial population percentage level as Dr. Ricchetti assumes in his analysis. Dr. Ricchetti appears to be developing some type of new police racial bias theory or is applying the existing racial profiling literature in some novel and untested manner.... In my 19 years of professional experience with working in this area of research, I have not seen police racial bias analysis performed in the manner that Dr. Ricchetti does in his report."). Steward Report ¶, 47 ("It is generally recognized that the driving population on a given road can vary from the residential population in the area of the road for any number of reasons. Commercial and retail activity frequently draws individuals onto area roads that are demographically different from the persons who live in the residences surrounding the roads.").

roadblocks, Dr. Steward's argument misunderstands and misrepresents Dr. Ricchetti's model.

19. I have reviewed Dr. Ricchetti's analysis and model. Dr. Ricchetti's model includes direct controls for drunk driving and traffic violations of *drivers* in each census tract. In other words, Dr. Ricchetti's model controls for the relevant behavior of drivers in each census tract. While Dr. Steward emphasizes the importance of DUIs in the establishment of roadblocks (calling it "the key factor"), Dr. Ricchetti's model controls for DUIs.² Thus, contrary to Dr. Steward's claims and consistent with the literature, Dr. Ricchetti controls for the relevant behavior of driving population in each census tract, given the focus on roadblock policing.
20. I do not understand Dr. Ricchetti's model's use of the share of African-Americans living in a census tract as a proxy for the share of drivers in that census tract that are African-American. Instead, Dr. Ricchetti's model uses the share of population that is African-American in each census tract to test of whether there are more roadblocks in some areas of the county than others, *controlling for driving behavior*.
21. This type of model, in which a researcher looks at differential policing across different neighborhoods based on racial breakdown of residents in the neighborhood while controlling for relevant crime in each neighborhood, has been used in both academic research and relied on by Courts. I am the author of a paper that surveys key papers in the economic and statistics literature on crime.³ In that paper, I cite to a paper by Jeff Fagan and co-authors ("Fagan et al.") as an example that uses the same general type of model Dr. Ricchetti uses to assess whether the Stop, Question, and Frisk program in New York City (SQF) was used more heavily in minority neighborhoods, while controlling for crime levels.⁴ As in Dr. Ricchetti's

² See, for example, Steward Report, ¶ 11 ("... DUI activity and not race, is the key factor in MCSD traffic roadblock location placement."); Steward Report, ¶ 58 ("It my understanding that MCSD receives grant funding from Mississippi Office of Highway Safety (MOHS) in its efforts to reduce the incidents of drunk driving and to assist with cost of establishing DUI traffic roadblocks. It is my understanding that the grant funding is subject to periodic renewal and is contingent on satisfactory achievement of DUI enforcement. Even a cursory look at the traffic roadblock and CAD data shows that the DUI activity in a geographical area during a specific time period is correlated with an increased number of traffic roadblocks in the geographical area in later time periods.").

³ Chaffin, Aaron, and Justin McCrary, "Criminal Deterrence: A Review of the Literature," *Journal of Economic Literature*, 55(1), 2017, pp. 5–48.

⁴ Chaffin, Aaron, and Justin McCrary, "Criminal Deterrence: A Review of the Literature," *Journal of Economic Literature*, 55(1), 2017, pp. 5–48, at p. 21; Fagan, Jeffery A., et al., "Street Stops and Broken Windows Revisited: The Demography and Logic of Proactive Policing in a Safe and Changing City," Stephen K. Rice and Michael D. White

- model, Fagan et al. examined whether the intensity of a particularly type of policing effort varied across neighborhoods based on the racial distribution of *the residents* in that neighborhood, given the level of relevant crimes committed in those neighborhoods. Prof. Fagan and his co-authors have in fact published several articles using this broad methodology.⁵ I also understand that Prof. Fagan's methodology was used in *Floyd et al. v. the City of New York* and the model was accepted by the Courts.⁶ Such an approach can be (and, in this particular instance in my opinion, is) a methodologically appropriate approach to determine whether there is a statistically significant relationship between roadblock placement and the racial composition of a census tract, conditional on other factors.
22. More generally, the literature on crime and policing regularly leverages different levels of crime and policing across different geographic areas (cities, counties, etc.) to understand the relationships between crime, policing, and local characteristics of different geographic areas.⁷ Dr. Ricchetti's general methodology of using differences across geographic areas to analyze a relationship between roadblocks, drunk driving, and other traffic offenses, and neighborhood characteristics employs an accepted methodology that is widely applied to many questions. For example, this general methodology broadly parallels that used in an article by Sarath Sanga on race and policing in Oakland in a leading peer review journal.⁸
 23. The general model Dr. Ricchetti uses is also commonly employed to investigate how differences across neighborhoods affects a variety of different social, political, and economic outcomes. For example, the model is commonly used in studies examining voting patterns across localities. Typical of this approach is a recent paper by Elizabeth Cascio and Ebonya Washington examining the connection

(Eds.), *Race, Ethnicity, and Policing: New and Essential Readings*, New York University Press, New York and London, 2009, pp. 309–348.

⁵ See, for example, Gelman, Andrew, Jeffrey Fagan, and Alex Kiss, “An Analysis of the New York City Police Department's ‘Stop-and-Frisk’ Policy in the Context of Claims of Racial Bias,” *Journal of American Statistical Association*, 109(479), 2007, pp. 813–823.

⁶ Opinion and Order, *Floyd et al. v. the City of New York*, May 16, 2012 at pp. 6–7.

⁷ For example, my paper with Aaron Chalfin summarizes a large academic literature that utilizes aggregate data at different geographic levels to analyze factors that contribute to different levels of crime and policing across different geographic areas. Some of those papers include control variables for demographic factors like race. Chalfin, Aaron, and Justin McCrary, “Criminal Deterrence: A Review of the Literature,” *Journal of Economic Literature*, 55(1), 2017, pp. 5–48.

⁸ Sanga, Sarath, “Does Officer Race Matter?” *American Law and Economics Review*, 16(2), 2014, pp. 403–432, especially Section 6.

between the Voting Rights Act and redistribution of state funds (“Cascio and Washington”). This paper was published in another leading peer review journal, the *Quarterly Journal of Economics*.⁹

24. The type of regression used by Cascio and Washington is analogous to regression models involving controls for area racial composition in a vast array of voting rights cases. These cases are too numerous to mention here but are summarized in detail in *Quiet Revolution in the South*, a leading monograph published by one of the top academic presses in the world, the Princeton University Press (“Quiet Revolution”).¹⁰ *Quiet Revolution* is also an important work of social science literature and draws upon the same type of regression analysis Dr. Ricchetti employs in his report.
25. The type of model Dr. Ricchetti uses is also a common model used for understanding how different economic outcomes differ across neighborhoods of differing racial composition. For example, area-level measures of racial composition are employed by David Card and Jesse Rothstein in a paper examining the empirical relationship between racial composition in census tracts and the black-white test score gap.¹¹ Ed Glaeser and David Cutler of Harvard used the same broad methodology to analyze how employment and school outcomes differ across census tracts with different degrees of racial segregation.¹² There is also a literature that uses the same methodology to analyze how mortgage lending outcomes vary with the racial composition of neighborhoods.¹³
26. I have three final comments on Dr. Ricchetti’s model. First, in my experience with the literature, a relative strength of Dr. Ricchetti’s model as applied to the context at hand is that it tests the relationship between race and law enforcement with respect to a relatively narrow policing activity that has a measurable objective that both

⁹ Cascio, Elizabeth U., and Ebonya Washington “Valuing the Vote: The Redistribution of Voting Rights and State Funds following the Voting Rights Act of 1965,” *Quarterly Journal of Economics*, 129(1), 2014, pp. 379–433, especially at pp. 389–393.

¹⁰ Davidson, Chandler, and Bernard Grofman (Eds.), *Quiet Revolution in the South: The Impact of the Voting Rights Act, 1965-1990*, Princeton University Press, Princeton, NJ, 1994.

¹¹ Card, David, and Jesse Rothstein, “Racial Segregation and the Black-White Test Score Gap,” *Journal of Public Economics*, 91(11-12), 2007, pp. 2158–2184.

¹² Cutler, David M., and Edward L. Glaeser, “Are Ghettos Good or Bad?” *Quarterly Journal of Economics*, 112(3), 1997, pp. 827–872.

¹³ Rougeau, Vincent D., and Keith N. Hylton, “Lending Discrimination: Economic Theory, Econometric Evidence, and the Community Reinvestment Act,” *The Georgetown Law Journal*, 85(237), 1996, pp. 237–294, at pp. 269-270, 277, 289.

experts generally agree upon – namely the reduction of unsafe driving. As noted above, Dr. Steward agrees that the objective of roadblocks is the reduction of unsafe driving and cites to documents in his own report to support this claim.¹⁴ Further, both Dr. Steward and Dr. Ricchetti have access to data from the sheriff's department tracking DUIs and other traffic offenses, and both have argued DUIs are the key factor that correlates with roadblocks. Often times in academic research on crime, the outcomes being analyzed have complex causal chains and not all data is available, making the conclusions that can be drawn relatively weaker than those Dr. Ricchetti is able to draw here.

27. Second, Dr. Steward claims that Dr. Ricchetti's analysis somehow assumes that "police racial profiling bias can be expected to occur at some specific racial population percentage level."¹⁵ I have reviewed Dr. Ricchetti's model, and I do not understand it to be making any such assumption. Dr. Ricchetti's regression model simply analyzes the relationship between the share of population that is African-American in each census tract and roadblock frequency. I do not understand his analysis to impose assumptions regarding the form of any racial bias on the part of police. Dr. Steward's claims on this point appear to stem from his misunderstanding of a set of descriptive statistics in Dr. Ricchetti's first report. Dr. Ricchetti's regression analysis – which is the formal statistical test of the relationship between race and roadblocks – imposes no such assumption.
28. Third, Dr. Steward criticizes the descriptive statistics section of Dr. Ricchetti's report.¹⁶ While it is true Dr. Ricchetti presents a set of summary statistics that identify what a statistician would call a "bi-modal distribution" of race across census tracts (i.e., the share of African-Americans in each census tract clusters around two levels – less than 25% or approximately 50% or more), Dr. Ricchetti's use of summary statistics to describe relevant patterns in the data before running his full regression model is a common approach in nearly every academic paper that uses regression. Such statistics are not meant to be offered as a formal statistical test, as Dr. Steward claims, and instead provide relevant background regarding the variation in racial composition across census tracts before running a formal regression model.

¹⁴ Steward Report, ¶¶ 57–61.

¹⁵ Steward Report, ¶ 39.

¹⁶ Steward Report, ¶¶ 34–39.

2.2. Dr. Steward's claims about race and census tracts

29. The second criticism Dr. Steward offers of Dr. Ricchetti's use of geographic data is equally misplaced. Dr. Steward asserts that the fact that there is variation within each census tract in the share of the population that is African-American "further undercuts the reliability of his analyses."¹⁷ This assertion by Dr. Steward reveals a basic misunderstanding of geographic data, is inconsistent with basic econometric methods used in a great many published papers, and is simply inaccurate.
30. As discussed above in Section 2.1, it is common for academic papers to use data aggregated to a geographic level (like a census tract) to analyze crime and policing, as well as different outcomes by race more generally. Multiple notable academic studies that have analyzed how the racial composition of a neighborhood affects economic outcomes use census tract data.¹⁸ In fact, the U.S. Department of Housing and Urban Development ("HUD") developed a randomized social experiment in the 1990's (called Moving to Opportunity ("MTO")) to analyze the effect of moving from a relatively higher poverty neighborhood to a relatively lower poverty neighborhood on children's educational and economic outcomes.¹⁹ The MTO study defined neighborhoods as census tracts, and the data from the MTO study has been analyzed by leading economists in top academic journals, including Raj Chetty and Larry Katz.²⁰
31. Thus, the use of census tract level data – or county data, or city data, or state data – is common in academic research, and is in no way invalidated because the values of the variables vary within a census tract (or county, or city, or state) as Dr. Steward asserts. This feature of data is true for any variable that is measured at an aggregate geographic level, such as census tract, county, city, or state level. Consequently, statistical analyses comparing differences across neighborhoods in policing or any other outcome of interest can be a reliable methodology. Any conclusion to the contrary would be overly broad and incorrect. In fact, I understand Dr. Steward has

¹⁷ Steward Report, ¶ 46.

¹⁸ Card, David, and Jesse Rothstein, "Racial Segregation and the Black-White Test Score Gap," *Journal of Public Economics*, 91(11-12), 2007, pp. 2158–2184; Cutler, David M., and Edward L. Glaeser, "Are Ghettos Good or Bad?" *Quarterly Journal of Economics*, 112(3), 1997, pp. 827–872. Both papers use census tracts.

¹⁹ "Moving to Opportunity for Fair Housing," available at *U.S. Department of Housing and Urban Development*, <https://www.hud.gov/programdescription/mto>

²⁰ Chetty, Raj, Nathaniel Hendren, and Lawrence F. Katz, "The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment," *American Economic Review*, 106(4), 2016, pp. 855–902.

relied on comparisons of arrest data across geographic areas much bigger than census tracts in a benchmarking analysis in a prior matter where he served as the Plaintiff's expert.²¹

32. In fact, the use of aggregate data within a geographic unit is well understood to be a particular type of measurement error that does not create bias in favor of finding a statistically significant coefficient on race in a regression analysis. As I explain in more detail in the next section, if anything this type of measurement issue typically makes a model like Dr. Ricchetti's conservative.

²¹ Plaintiffs' Opposition to Defendants' Joint Motion to Exclude Dwight Steward, Ph.D., as an Expert Witness, *Kelly v. Paschall*, February 24, 2005.

3. MEASUREMENT ERROR IS A WELL-UNDERSTOOD FEATURE OF GEOGRAPHIC ANALYSIS THAT TYPICALLY MAKES AN ANALYSIS CONSERVATIVE

33. Dr. Steward points to two examples of a standard methodological issue in econometrics known as measurement error and suggests that such measurement errors render Dr. Ricchetti's analysis unreliable. As I describe below, Dr. Steward's arguments on these points are methodologically unsound, unsupported by the literature, and misunderstand measurement error and the associated statistical theory. I note that I have written specifically on the subject of measurement error in criminal justice and am familiar with the extensive literature on the subject.²²

3.1.1. *Measurement error in the number of roadblocks*

34. First, Dr. Steward claims that the fact that some of the roadblocks that Dr. Ricchetti analyzes occur on the boundary of census blocks makes it "difficult, if not impossible, to determine the level and direction of the errors that his faulty methodology introduces into his analysis,"²³ and that it "is unacceptable and unreasonable to assume that his errors will 'wash out' in the end."²⁴ Dr. Steward's statements are incorrect and methodologically unsound. In fact, in his deposition testimony, Dr. Steward appears to misunderstand the definition of measurement error.²⁵

35. It is well understood in economics and statistics that nearly all data sources have imperfections in them that introduce the possibility of what economists refer to as measurement error.²⁶ Importantly, the effect of measurement error in a context such as that analyzed by Dr. Ricchetti is not to make analysis "impossible," but instead

²² Chalfin, Aaron, and Justin McCrary, "Are U.S. Cities Underpoliced? Theory and Evidence," *Review of Economics and Statistics*, 100(1), 2018, pp. 167–186.

²³ Steward Report, ¶ 32.

²⁴ Steward Report, ¶ 32.

²⁵ Deposition of Dwight Steward, Ph.D., June 22, 2018, pp. 186:17–187:10 ("Q. And what is your understanding of that term [measurement error]? A. Measurement error is not data error. Measurement error is a completely statistical term. And again, it has to do with a tool, not with the data. Measurement error just has to do with accounting for the fact that there are going to be some things you can't measure. The classic example is fire in the belly when you're looking at salary. You're going to have some people that work really hard and other people that don't really hard. But on average, when you're doing a salary analysis, it balances out.").

²⁶ Angrist, Joshua D., and Alan B. Krueger, "Empirical Strategies in Labor Economics," Orley C. Ashenfelter and David Card (Eds.), *Handbook of Labor Economics*, 1999, pp. 1277–1366, at pp. 1339–1340.

to make an analysis conservative. For example, a leading econometrics textbook notes the following:²⁷

“The usual assumption is that the measurement error in [a dependent variable] is statistically independent of each explanatory variable. If this is true, then the OLS estimators [the regression coefficients] are unbiased and consistent. Further, the usual OLS inference procedures (*t*, *F*, *LM* statistics are valid)... measurement error in the dependent variable results in a larger variance than when no error occurs; this, of course, results in larger variances of the OLS estimators.... The bottom line is that, if the measurement error is uncorrelated with the independent variables, then OLS estimation has good properties.”

36. As described in the above quote, the existence of measurement error in the dependent variable (the issue Dr. Steward focuses on) typically has *no effect* on the reliability of a regression model. The only effect of measurement error is to increase the variance of the model, which makes it *harder* to find a statistically significant effect for any variable in the model. Thus, to the extent there is measurement error in Dr. Ricchetti’s model, the statistical significance of the race variable is conservative.
37. One way in which the measurement error Dr. Steward identifies could conceivably change Dr. Ricchetti’s findings is if the roadblocks on boundaries were systematically mis-assigned to census tracts in a very specific way that correlated, after controlling for the other covariates in his model, with census tract racial composition.²⁸ Importantly, there are standard ways to test for such a concern. For example, one way to test for such a concern is to run robustness tests that exclude from the model any data points in which measurement error might be a problem.²⁹

²⁷ Wooldridge, Jeffery M., *Introductory Econometrics: A Modern Approach*, 5th Edition, South-Western Cengage Learning, Mason, Ohio, 2012, pp. 318–319.

²⁸ Wooldridge, Jeffery M., *Introductory Econometrics: A Modern Approach*, 5th Edition, South-Western Cengage Learning, Mason, Ohio, 2012, p. 320 (“The bottom line of this subsection is that measurement error in the dependent variable *can* cause biases in OLS if it is systematically related to one or more of the explanatory variables. If the measurement error is just a random reporting error that is independent of the explanatory variables, as is often assumed, then OLS is perfectly appropriate.”).

²⁹ Rubinfield, Daniel L., “Reference Guide on Multiple Regression,” *Reference Manual on Scientific Evidence*, 3rd Edition, Federal Judicial Center, the National Academies Press, Washington, D.C., 2011, p. 327 (“In general, it is important to explore the reasons for unusual data points. If the source is an error in recording data, the appropriate corrections can be made. If all the unusual data points have certain characteristics in common (e.g., they all are associated with a supervisor who consistently gives high ratings in an equal pay case), the regression model should be modified appropriately. One

Rather than use those standard tests, Dr. Steward simply asserts measurement error is a problem. Dr. Steward does not in any way *test* whether it affects Dr. Ricchetti's findings. Based on standard econometric conclusions, the expectation for this type of measurement error would in fact be for it to "wash out" in the analysis. Dr. Steward makes no attempt to demonstrate that his concern is well-founded. In my opinion, the type of measurement error Dr. Steward identifies is highly unlikely to affect Dr. Ricchetti's conclusions, except by making them somewhat conservative from a statistical perspective.

38. Further, and more practically, I have reviewed Dr. Ricchetti's rebuttal report, and understand that when he removes the roadblocks on or near boundaries (the roadblocks that could be subject to measurement error), his main findings are unchanged. Dr. Ricchetti also runs a sensitivity in which he moves all roadblocks on the boundary into the census tract they border with the lowest African-American share. This sensitivity directly tests Dr. Steward's concern that the relationship between roadblocks and African-American share that Dr. Ricchetti finds is driven entirely by how data points on the boundary are assigned to census tracts. Dr. Ricchetti's findings again remain unchanged despite this assumption. These types of sensitivities indicate that any measurement error introduced by the existence of roadblocks on boundaries is not driving Dr. Ricchetti's results.
39. More generally, in my professional experience publishing papers, serving as a referee, determining tenure for junior scholars, and writing on criminal justice from an empirical perspective, it is my view that the type of data issue that Dr. Steward highlights is present in some form in a great number of empirical analyses and that the presence of some form of imperfection in data does not on its own necessarily render such analyses scientifically unreliable. To argue that, because imperfections such as those that are present in the data Dr. Ricchetti employs, an analysis should not be conducted, or is unreliable, is not standard.

3.1.2. Measurement error in the share of African-Americans by census tract

generally useful diagnostic technique is to determine to what extent the estimated parameter changes as each data point in the regression analysis is dropped from the sample."); Angrist, Joshua D., and Alan B. Krueger, "Empirical Strategies in Labor Economics," Orley C. Ashenfelter and David Card (Eds.), *Handbook of Labor Economics*, 1999, pp. 1277–1366, at p. 1347 ("Researchers have employed a variety of 'trimming' techniques to try to minimize the effects of observations that may have been misreported.").

40. As noted above, Dr. Steward also asserts that the fact that there is variation within each census tract in the share of the population that is African-American “further undercuts the reliability of his analyses.”³⁰ As discussed above in Section 2, there are a great number of academic papers that use data aggregated to a geographic level (like a census tract) to analyze crime and policing, as well as different outcomes by race. The use of census tract level data is in no way invalidated because the values of the variables vary within a census tract. This feature of data is true for any variable that is analyzed at a census tract, county, city, or state level. Dr. Steward is simply wrong that this aspect of Dr. Ricchetti’s analysis “undercuts [its] reliability.”
41. In fact, measurement error in a control variable (like the share of the population in a census tract that is African-American) is typically understood to make the estimate of a coefficient *smaller* than otherwise would be the case. In fact, and as noted, one of my published papers on crime and policing focuses specifically on how the presence of measurement error will understate the relationship between policing and crime. In that paper, I described the concern of measurement error in a predicting variable as follows:³¹

“An obvious way to improve the precision of police elasticities is to return to regression-based methods with appropriate controls, as in Marvell and Moody (1996), for example. Importantly, however, this type of approach has the potential to run afoul of the ‘iron law of econometrics,’ or the tendency of regression coefficients to be too small because of errors in the measurement of the variable of interest (Hausman 2001).”

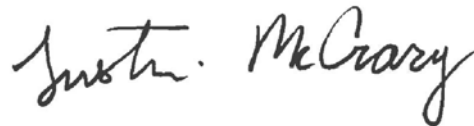
³⁰ Steward Report, ¶ 46.

³¹ Chalfin, Aaron, and Justin McCrary, “Are U.S. Cities Underpoliced? Theory and Evidence,” *Review of Economics and Statistics*, 100(1), 2018, pp. 167–186.

4. CONCLUSION

42. In sum, based on my review of Dr. Steward's and Dr. Ricchetti's reports, it is my view that Dr. Ricchetti's statistical model is a commonly-used and widely-accepted methodology in both the academic literature and by the Courts in litigation. Dr. Steward's claims to the contrary are simply not supported. In fact, as noted above, Dr. Steward has relied on the same methodology of comparing policing outcomes across different broad geographic regions himself in a prior case.
43. Additionally, Dr. Steward's claim that the existence of roadblocks on the boundary of census tracts renders Dr. Ricchetti's analyses unreliable is not correct. Dr. Steward's claims on this subject are contradicted by standard econometric methodology covered in basic textbooks, and by the large academic literature in economics and statistics on measurement error. Dr. Ricchetti's approach of using sensitivity analyses to test the potential effect of measurement error is a standard approach to this problem. The fact that Dr. Steward did not run any such tests to support his claims is not an accepted approach.

Executed on July 2, 2018

A handwritten signature in black ink that reads "Justin. McCrary". The signature is written in a cursive, slightly informal style.

Justin McCrary, Ph.D.

Appendix A

Justin McCrary

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Current Appointments

Columbia University
2018– Paul J. Evanson Professor of Law (effective July 1, 2018)

University of California, Berkeley
2010– Professor of Law
2008–10 Assistant Professor of Law

National Bureau of Economic Research
2012– Faculty Research Associate
2006–12 Faculty Research Fellow

Past Appointments

Columbia University
Fall 2017 Samuel Rubin Visiting Professor of Law

University of California, Berkeley
2014–17 Director, Social Sciences Data Laboratory (D-Lab)

University of Michigan
2003–07 Assistant Professor, Gerald R. Ford School of Public Policy
2003–07 Assistant Professor, Department of Economics (courtesy)

Education

Ph.D. Economics, University of California, Berkeley, 2003

A.B. Public Policy, Princeton University, 1996

Testimony Experience

In Re: RFC and ResCap Liquidating Trust Litigation

U.S. District Court for the District of Minnesota and

U.S. Bankruptcy Court for the Southern District of New York

Mortgage-backed securities case

Testimony regarding sampling, damages, and statistical concepts

Retained by Advanced Financial Services, BMO Harris Bank, Cadence Bank, Colonial Savings, CTX Mortgage, Decision One, First Guaranty, Freedom Mortgage, Home Loan Center, HSBC Mortgage, Impac Funding, PNC, Provident, Standard Pacific, Synovus, and Universal American

Report filed on June 15, 2018

Deposed on April 24, 2018

Rebuttal to supplemental disclosure filed on February 26, 2018

Rebuttal report filed on October 27, 2017

Tri-City, LLC; Endor Car and Driver, LLC; Zehn-NY, LLC; Zwei-NY, LLC; Abatar, LLC; and Flatiron Transit, LLC v. New York Taxi and Limousine Commission and Meera Joshi

Supreme Court of the State of New York, County of New York

Article 78 proceeding challenging an administrative ruling

Testimony regarding mismatch between accessibility regulation and accessibility demand

Retained by plaintiffs

Supplemental report filed on May 18, 2018

Affirmative report filed on April 13, 2018

Federal Home Loan Bank of Boston, v. Ally Financial, Inc., et al.

Superior Court of the State of Massachusetts, Business Litigation Session, Suffolk County

Mortgage-backed securities case

Testimony regarding sampling and statistical methods

Retained by Morgan Stanley

Rebuttal report filed on May 17, 2018

Cheryl Phipps and Shawn Gibbons v. Wal-Mart Stores, Inc.

United States District Court for the Middle District of Tennessee

Putative class action alleging discrimination in employment

Testimony regarding the decentralized nature of Walmart's internal labor market and concomitant heterogeneity across proposed class members in pay and promotion outcomes

Retained by Walmart

Deposed on April 30, 2018

Rebuttal report filed on April 20, 2018

People of the State of California v. Morgan Stanley & Co.

Superior Court of the State of California, County of San Francisco

Mortgage-backed securities case

Testimony regarding sampling and statistical methods

Retained by Morgan Stanley & Co.

Deposed on February 9, 2018

Rebuttal report filed on January 25, 2018

Tony Dickey and Paul Parmer et al. v. Advanced Micro Devices, Inc.

U.S. District Court for the Northern District of California

Putative class action alleging false advertising

Testimony regarding availability of information regarding and market for computer chips and heterogeneity across putative class members

Retained by Advanced Micro Devices

Rebuttal report filed on January 26, 2018

Martin Dulberg et al. v. Uber Technologies, Inc. and Rasier, LLC

U.S. District Court for the Northern District of California

Putative class action alleging breach of contract

Testimony regarding heterogeneity in damages across putative class members

Retained by Uber Technologies, Inc.

Affirmative report filed on January 11, 2018

Federal Home Loan Bank of Chicago v. Banc of America Funding Corporation, et al.

Circuit Court of Cook County, Illinois, County Department, Chancery Division

Mortgage-backed securities case

Testimony regarding sampling, regression, and statistical methods

Retained by Morgan Stanley

Deposed on December 14, 2017

Rebuttal report filed on August 21, 2017

In re Lehman Brothers Holdings, Inc., et al., Debtors

U.S. Bankruptcy Court for the Southern District of New York

Mortgage-backed securities case

Testimony regarding sampling, resampling methods for inference, and statistical methods

Retained by Lehman Brothers Holdings, Inc.

Deposed on October 9, 2017

Rebuttal report filed on August 28, 2017

In re Gateway Plaza Residents Litigation

Supreme Court of the State of New York, County of New York

Putative class action regarding warranty of habitability

Testimony regarding electricity usage, individual preferences and choices, and heterogeneity across putative class members; large scale data analysis

Retained by Gateway Plaza

Class certification report filed on September 18, 2017

Shamrell v. Apple Inc.

Superior Court of the State of California, County of San Diego

Putative class action regarding products liability, Unfair Competition Law and Consumers Legal Remedies Act

Testimony regarding heterogeneity across putative class members, failure rate methodologies, econometrics, and data science

Retained by Apple, Inc.

Class certification report filed on March 29, 2017

Rebuttal report filed on February 1, 2017

Deutsche Bank National Trust Company v. Morgan Stanley Mortgage Capital Holdings LLC

U.S. District Court for the Southern District of New York

Mortgage-backed securities case

Testimony regarding sampling and statistical methods

Retained by Morgan Stanley Mortgage Capital Holdings LLC

Deposed on March 27, 2017

Rebuttal report filed on December 16, 2016

Rosen v. Uber Technologies, Inc.

U.S. District Court for the Northern District of California

Putative class action regarding false advertising

Testimony regarding economics of safety

Retained by Uber Technologies, Inc.

Deposed on February 3, 2017

Rebuttal report filed on January 13, 2017

Affirmative report filed on December 2, 2016

Blackrock Allocation Target Shares: Series S Portfolio, et al., v. Wells Fargo Bank, N.A.; Royal Park Investments SA/NV v. Wells Fargo Bank, N.A., as Trustee; National Credit Union Administration Board, et al., v. Wells Fargo Bank, N.A.; Phoenix Light SF Limited, et al., v. Wells Fargo Bank, N.A.; and Commerzbank AG v. Wells Fargo Bank, N.A.

U.S. District Court for the Southern District of New York

Mortgage-backed securities case

Testimony regarding sampling and statistical methods

Retained by Wells Fargo Bank

Report filed on January 18, 2017

LA Taxi Cooperative, Inc. et al. v. Uber Technologies, Inc.

U.S. District Court for the Northern District of California

False advertising case

Testimony regarding economics of safety

Retained by Uber Technologies, Inc.

Rebuttal report filed on January 13, 2017

Affirmative report filed on November 18, 2016

State of Illinois v. Hitachi Ltd., et al.

Circuit Court of Cook County, Illinois, County Department, Chancery Division

Antitrust price-fixing case

Testimony regarding liability and damages

Retained by Hitachi Ltd.

Report filed on November 11, 2016

In re: City of San Bernardino, California, Debtor

U.S. Bankruptcy Court, Central District of California, Riverside Division

Municipal bankruptcy case

Testimony regarding economics, econometrics, rare risks and the value of a statistical life

Retained by the City of San Bernardino

Report filed on October 3, 2016

U.S. Bank National Association v. Morgan Stanley Mortgage Capital Holdings LLC
Supreme Court of the State of New York, County of New York
Mortgage-backed securities case
Testimony regarding sampling and statistical methods
Retained by Morgan Stanley Mortgage Capital Holdings LLC
Deposed on September 10, 2016
Report filed on June 17, 2016

National Credit Union Administration Board v. RBS Securities, Inc.
U.S. District Court for the Central District of California &
U.S. District Court for the District of Kansas
Mortgage-backed securities case
Testimony regarding sampling and statistical methods
Retained by RBS Securities
Deposed on January 28, 2016
Report filed on October 16, 2015

Temple-Inland, Inc., v. Thomas Cook, et al.
U.S. District Court for the District of Delaware
Escheat law case
Testimony regarding sampling, statistical methods, and economic theory
Retained by the State of Delaware
Deposed on November 24, 2015
Report filed on October 23, 2015

National Consumer Protection Service v. Farmacias Cruz Verde S.A. et al.
Honorable Civil Court of Santiago (Chile)
Antitrust putative class action
Testimony regarding appropriate methods for estimating damages
Retained by Salcobrand
Report filed on November 14, 2015

Douglas O'Connor, et al., v. Uber Technologies, Inc.
U.S. District Court for the Northern District of California
Putative class action regarding independent contractor versus employee
Testimony regarding heterogeneity in alleged damages across putative class members, potential for class conflict
Retained by Uber Technologies, Inc.
Report filed on October 27, 2015
Report filed on July 7, 2015

Students for Fair Admissions, Inc. v. President and Fellows of Harvard College
U.S. District Court for the District of Massachusetts
Discovery dispute in affirmative action case
Testimony regarding necessary inputs into statistical methodologies
Retained by Harvard College
Report filed on July 30, 2015

Securities and Exchange Commission v. James V. Mazzo and David L. Parker

U.S. District Court for the Central District of California

Civil insider trading suit

Testimony regarding probability theory and statistics

Retained by James V. Mazzo and David L. Parker

Deposed on May 13, 2015

Report filed on March 13, 2015

In re: City of Stockton, California, Debtor

U.S. Bankruptcy Court, Eastern District of California

Municipal bankruptcy suit

Testimony regarding economic theory, labor economics, and econometrics

Retained by the City of Stockton

Deposed on March 13, 2013

Report filed on February 15, 2013

In the Matter of Act 111 Interest Arbitration Between Commonwealth of Pennsylvania and Pennsylvania State Troopers Association

Hearings on wage setting

Testimony regarding rare risks and the value of a statistical life

Retained by the Pennsylvania State Troopers Association

Testimony given on December 4, 2012

Report filed on December 4, 2012

Scholarship on Sampling, Statistics, and Econometrics

Conservative Tests Under Satisficing Models of Publication Bias (with Garret Christensen and Daniele Fanelli)

PLOS One, Volume 11, Number 2, February 22, 2016

New Evidence on the Finite Sample Properties of Propensity Score Matching and Reweighting Estimators (with Matias Busso and John DiNardo)

Review of Economics and Statistics, Volume 96, Number 5, December 2014

Incomes in South Africa Since the Fall of Apartheid (with Murray Leibbrandt and James Levinsohn)

Journal of Globalization and Development, Volume 1, Issue 1, January 2010

Manipulation of the Running Variable in the Regression Discontinuity Design: A Density Test

Journal of Econometrics, Volume 142, Issue 2, February 2008

Scholarship on Risk and Crime

Are U.S. Cities Underpoliced? Theory and Evidence (with Aaron Chalfin)

Review of Economics and Statistics, Volume 100, Issue 1, March 2018, 167–186

Criminal Deterrence: A Review of the Literature (with Aaron Chalfin)

Journal of Economic Literature, Volume 55, Number 1, March 2017, 5–48 (lead article)

The Deterrence Effect of Prison: Dynamic Theory and Evidence (with David S. Lee)

Advances in Econometrics, Volume 38, 2017

Do Sexually Violent Predator Laws Violate Double Jeopardy or Substantive Due Process: An Empirical Inquiry (with Tamara Lave)

Brooklyn Law Review, Volume 78, Summer 2013, Number 4, 1391–1439

General Equilibrium Effects of Prison on Crime: Evidence From International Comparisons (with Sarath Sanga)
Cato Papers on Public Policy, Volume 2, 2012

Controlling Crime: Strategies and Tradeoffs (co-edited with Phil Cook and Jens Ludwig), Chicago: University of Chicago Press, 2011.

Scholarship on Competition

Measuring Benchmark Damages in Antitrust Litigation (with Daniel L. Rubinfeld)
Journal of Econometric Methods, Volume 3, January 2014

Scholarship on Finance

Dark Trading at the Midpoint: Pricing Rules, Order Flow, and Price Discovery (with Robert Bartlett)
Accepted, *Journal of Law, Finance, and Accounting*

How Rigged Are Stock Markets?: Evidence from Microsecond Timestamps (working paper, 2016, with Robert Bartlett)

Shall We Haggle in Pennies at the Speed of Light or in Nickels in the Dark?: How Minimum Price Variation Regulates High Frequency Trading and Dark Liquidity (working paper, 2015, with Robert Bartlett)

Scholarship on Labor Economics

Unmarked? Criminal Record Clearing and Employment Outcomes (with Jeffrey Selbin (lead author) and Joshua Epstein)
Journal of Criminal Law and Criminology, Volume 108, Number 1, 2017 (lead article)

The Effect of Female Education on Fertility and Infant Health: Evidence from School Entry Laws Using Exact Date of Birth (with Heather Royer)
American Economic Review, Volume 101, Number 1, February 2011

Comment on "Free to Punish? The American Dream and the Harsh Treatment of Criminals", by Rafael di Tella and Juan Dubra
Cato Papers on Public Policy, Volume 1, 2011

Dynamic Perspectives on Crime
in *Handbook of the Economics of Crime*, Chapter 4, Edward Elgar, 2010

The Effect of Court-Ordered Hiring Quotas on the Composition and Quality of Police
American Economic Review, Volume 97, Number 1, March 2007

Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime: Comment
American Economic Review, Volume 92, Number 4, September 2002

Other Scholarship

The Ph.D. Rises in American Law Schools, 1960-2011: What Does It Mean for Legal Education? (with Joy Milligan and James Phillips)
Journal of Legal Education, Volume 65, Number 543, Spring 2016

Following Germany's Lead: Using International Monetary Linkages to Estimate the Effect of Monetary Policy on the Economy (with Julian di Giovanni and Till von Wachter)
Review of Economics and Statistics, Volume 91, Number 2, May 2009

Other Activities

- 2017– Member, Board of Directors, American Law and Economics Association
- 2014– Member, Quantitative Advisory Board, KOR Trading
- 2008– Co-Director (with Phil Cook and Jens Ludwig), *Crime Working Group*, National Bureau of Economic Research
- 2009–2014 Co-Director, *Law and Economics Program*, University of California, Berkeley

Courses Taught

Columbia

- 2017–2018 L6231-002: Corporations (Fall)

Berkeley

- 2016–2017 Law 244.4: Litigation and Statistics (Fall); Law 216: Law and Economics Workshop (Fall); Law 218.6: Law and Economics of Discrimination (Fall)
- 2015–2016 Law 250: Business Associations (Fall); Law 244.4: Litigation and Statistics (Fall); Letters and Science 39D: Race, Policing, and Data Science (Fall)
- 2014–2015 Law 250: Business Associations (Fall); Law 250S: Business Associations (Summer)
- 2013–2014 Law 250S: Business Associations (Summer)
- 2012–2013 Law 250: Business Associations (Fall); Law 250S: Business Associations (Summer); Law 209.3: Introductory Statistics (Fall)
- 2011–2012 Law 250: Business Associations (Fall); Law 250S: Business Associations (Summer); Law 209.3: Introductory Statistics (Fall); Law 251.31: Introduction to Law, Economics, and Business (Spring); Legal Studies 145: Law and Economics I (undergraduate)
- 2010–2011 Law 250: Business Associations (Fall); Law 250S: Business Associations (Summer); Law 216: Law and Economics Workshop (Fall and Spring); Legal Studies 145: Law and Economics I (undergraduate); Law 209.6: Topic in Quantitative Methods (JSP); Econ 250C: Labor Economics (graduate, shared course with 209.6)
- 2009–2010 Law 216: Law and Economics Workshop (Fall and Spring); Law 209.32: Quantitative Methods II (JSP)
- 2008–2009 Legal Studies 145: Law and Economics I (undergraduate); Law 209.3: Quantitative Methods I (JSP); Law 209.32: Quantitative Methods II (JSP)
- 2007–2008 Legal Studies 145: Law and Economics I (undergraduate); Law 209.3: Quantitative Methods I (JSP)

Michigan

Introduction to Quantitative Methods (policy), First Econometrics Field Course (economics), Advanced Economic Theory (policy)

Grants and Fellowships

- 2007–2010 NIH, Constructive Proposals for Dealing With Attrition (with John DiNardo)
- 2009 Committee on Research, Junior Faculty Research Grant, UC Berkeley
- 2006–2009 NIH, The Effect of Female Education on Fertility and Infant Health (with Heather Royer, Grant # R03 HD051713)

- 2006–2011 NSF, New Instrumental Variables Estimates of the Effects of Schooling and Military Service: Empirical Strategies Using Non-Public-Use Data (with Josh Angrist and Stacey Chen)
- 2005 RWJ Foundation Health and Society Scholars Program, Small Grant Program
- 2004 Rackham Interdisciplinary Grant, University of Michigan
- 2004 CLOSUP Grant, University of Michigan
- 2004 National Poverty Center Grant, University of Michigan
- 2002–2003 Chancellor’s Dissertation Year Fellowship, UC Berkeley

Presentations

- 2017–2018 Columbia University, School of Law; Georgetown University, School of Law
 - 2016–2017 George Mason University, School of Law; University of Michigan, Economics Department (Summer, Fall); Equities Leaders Summit; University of Zürich, Department of Economics; ETH (Swiss Federal Institute of Technology) Zürich, Law and Economics; Northwestern University, School of Law; Duke University, School of Law; Duke University, Information Initiative
 - 2015–2016 Goldman Sachs; University of California, Berkeley, School of Law; University of Virginia, School of Law; University of California, Irvine; Equal Employment Opportunity Commission; National Bureau of Economic Research, Summer Institute
 - 2014–2015 Duke University; Federal Reserve Bank of New York; Equal Employment Opportunity Commission (EEO-DataNet); American Law and Economics Association (discussant); New York University (NYU / Penn Law and Finance Conference); National Bureau of Economic Research, Summer Institute (discussant)
 - 2013–2014 University of Southern California, School of Law; London School of Economics; Bank of Spain; CEMFI; Carlos III; University of Zaragoza; University of Rotterdam; University of Maastricht; University of Göteborg
 - 2012–2013 University of California, Los Angeles, School of Law
 - 2011–2012 University of Oregon, Department of Economics; University of British Columbia, Department of Economics; Brown University, Department of Economics; University of Rochester, Department of Economics; Cato Institute; National Bureau of Economic Research, Summer Institute; Harvard Law School
 - 2010–2011 Northwestern, School of Law; University of Wisconsin, Department of Economics; Brookings Institution; Cato Institute
 - 2009–2010 University of Chicago, School of Law; Cornell University, School of Law and Department of Economics; University of Michigan, School of Law and Department of Economics; University of Virginia, School of Law, Olin Conference
 - 2008–2009 University of California, Los Angeles, School of Law; University of Arizona, School of Law and Department of Economics; Stanford University, School of Law and Department of Economics; University of Miami, Department of Economics
 - 2007–2008 Northwestern University, School of Law; University of Michigan, Department of Economics; National Bureau of Economic Research, Summer Institute; Florida State University
- Prior to 2007–2008, presentations are at departments of economics, unless otherwise noted*
- 2006–2007 University of Michigan, Program in Survey Methodology; Public Policy Institute of California; Brown University
 - 2005–2006 University of Michigan; University of California, Irvine; University of California, Santa Barbara; University of California, Santa Cruz; California State University, Long Beach; University of Western Ontario; University of Toronto; University of Illinois, Chicago; University of Chicago, Graduate School of Business; APPAM; University of Florida; University of California, Berkeley, School of Law; Princeton University; RAND; Hebrew University (conference in honor of Reuben Gronau); Stanford University, University of Wisconsin, Madison; Northwestern University; Crime and Economics Summer Workshop, University of Maryland

- 2004–2005 Federal Reserve Bank of Chicago; University of Illinois, Urbana-Champaign; University of Michigan, William Davidson Institute; University of Maryland; Urban Institute; American Economics Association Meetings; City University of New York Health Economics Seminar; University of Wisconsin, Madison; Stanford University; University of California, Davis; University of California, Berkeley, Labor Lunch; NBER Summer Institute, Education/Labor Studies
- 2003–2004 University of Michigan; APPAM; NBER Labor Studies Meeting (Fall); Massachusetts Institute of Technology; Harvard University, Kennedy School; University of California, Los Angeles; University of California, San Diego; Columbia University; University of California, Berkeley; NBER Summer Institute, Monetary Policy; NBER Summer Institute, Labor Studies
- 2002–2003 University of California, San Diego; University of California, Los Angeles; RAND Institute; University of Chicago, Graduate School of Business; University of Chicago, Harris School of Public Policy; University of Michigan, Ford School of Public Policy; Columbia University; Dartmouth College; Federal Reserve Bank of New York; Boston University

Last updated: June 16, 2018

Appendix B

Documents Considered by Justin McCrary, Ph.D.

Legal Pleadings

- Opinion and Order, *Floyd et al. v. the City of New York* May 16, 2012
- Plaintiffs' Opposition to Defendants' Joint Motion to Exclude Dwight Steward, Ph D , as an Expert Witness, February 24, 2005
Kelly v. Paschall

Expert Report

- Rebuttal Expert Report of Dwight D Steward, Ph D RE: Bryan Ricchetti, Ph D May 8, 2018

Depositions

- Deposition of Dwight Steward, Ph D June 22, 2018

Academic Literature

- Angrist, Joshua D , and Alan B Krueger, "Empirical Strategies in Labor Economics," Orley C Ashenfelter and David Card (Eds), *Handbook of Labor Economics* , pp 1277–1366 1999
- Card, David, and Jesse Rothstein, "Racial Segregation and the Black-White Test Score Gap," *Journal of Public Economics* , 91(11-12), pp 2158–2184 2007
- Cascio, Elizabeth U , and Ebonya Washington "Valuing the Vote: The Redistribution of Voting Rights and State Funds following the Voting Rights Act of 1965," *Quarterly Journal of Economics* , 129(1), pp 379–433 2014
- Chalfin, Aaron, and Justin McCrary, "Are U S Cities Underpoliced? Theory and Evidence," *Review of Economics and Statistics* , 100(1), pp 167–186 2018
- Chalfin, Aaron, and Justin McCrary, "Criminal Deterrence: A Review of the Literature," *Journal of Economic Literature* , 55(1), pp 5–48 2017
- Chetty, Raj, Nathaniel Hendren, and Lawrence F Katz, "The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment," *American Economic Review*, 106(4), pp 855–902 2016
- Cutler, David M , and Edward L Glaeser, "Are Ghettos Good or Bad?" *Quarterly Journal of Economics* , 112(3), pp 827–872 1997
- Davidson, Chandler, and Bernard Grofman, (Eds), *Quiet Revolution in the South: The Impact of the Voting Rights Act, 1965-1990* , Princeton University Press, Princeton, NJ 1994
- Fagan, Jeffrey A , et al , "Street Stops and Broken Windows Revisited: The Demography and Logic of Proactive Policing in a Safe and Changing City," Stephen K Rice and Michael D White (Eds) *Race, Ethnicity, and Policing: New and Essential Readings* , New York University Press, New York and London, pp 309–348 2009
- Gelman, Andrew, Jeffrey Fagan, and Alex Kiss, "An Analysis of the New York City Police Department's 'Stop-and-Frisk' Policy in the Context of Claims of Racial Bias," *Journal of American Statistical Association* , 109(479), pp 813–823 2007
- Rougeau, Vincent D , and Keith N Hylton, "Lending Discrimination: Economic Theory, Econometric Evidence, and the Community Reinvestment Act," *The Georgetown Law Journal* , 85(237), pp 237–294 1996
- Rubinfeld, Daniel L , "Reference Guide on Multiple Regression," *Reference Manual on Scientific Evidence* , 3rd Edition, Federal Judicial Center, the National Academies Press, Washington, D C 2011
- Sanga, Sarath, "Does Officer Race Matter?" *American Law and Economics Review* , 16(2), pp 403–432 2014
- Wooldridge, Jeffery M , *Introductory Econometrics: A Modern Approach* , 5th Edition, South-Western Cengage Learning, Mason, Ohio 2012

Public Press/Websites

- "Moving to Opportunity for Fair Housing," available at *U.S. Department of Housing and Urban Development* , <https://www.hud.gov/programdescription/mto>

EXHIBIT 5

IN THE UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF MISSISSIPPI
NORTHERN DIVISION

LATOYA BROWN; LAWRENCE)
BLACKMON; HERBERT ANTHONY)
GREEN; KHADAFY MANNING;)
QUINNETTA MANNING; MARVIN)
MCFIELD; NICHOLAS SINGLETON;)
STEVEN SMITH; BESSIE THOMAS;)
And BETTY JEAN WILLIAMS TUCKER,)
Individually and on behalf of a class of)
All others similarly situated,)

Plaintiffs,)

v.)

MADISON COUNTY, MISSISSIPPI;)
SHERIFF RANDALL S. TUCKER, in his)
Official capacity; and MADISON)
COUNTY SHERIFF'S DEPUTIES)
JOHN DOES #1 through #6, in their)
Individual capacities,)

Defendants.)

Civil Action No. 3:17-cv-347WHB-LRA

Dwight D. Steward, Ph.D.
Rebuttal Expert Report
RE: Bryan Ricchetti, Ph.D

May 8, 2018

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Introduction and summary of my opinions

1. My name is Dwight Steward, Ph.D. and I am an economist and statistician and have been retained to perform an analysis in this lawsuit. In this report, I provide a rebuttal to the Plaintiff's statistical expert, Dr. Bryan Ricchetti.

2. As an economist and statistician, I have provided statistical and economic consultation and reports on racial discrimination issues in areas including police racial profiling, police use of force, employment, and financial lending. I have provided statistical and economic research and expert witness testimony in court litigation and provided consultation in non-litigation settings to employers, governmental entities and police agencies.

3. In police agency projects, I have worked with civil rights organizations including the NAACP, LULAC, ACLU, and Texas Criminal Justice Coalition (TCJC), as well as police organizations such as the Police Executive Research Forum (PERF), on issues involving traffic stops, police searches, and police use of force. My co-authored statistical research of the Texas Department of Public Safety (DPS) stop and search database was one of the first large scale statistical studies of police racial profiling data in Texas. In addition, I worked for over seven years with the TCJC, ACLU, NAACP, and Texas police agencies on the statewide collection and analysis of police stop and search data and reports. Our research on the analysis of racial profiling allegations in Texas police agencies' stops and searches was cited by police racial profiling researchers and received national media attention. I have also assisted civil rights organizations and stakeholders, and members of the Texas State legislature, on the

development of a statewide repository for police agency racial profiling data and reports in Texas. During the Texas State 77th Legislature, I provided testimony to the Texas State Senate Research in support of the HB-1074 Bill: Racial Profiling in Texas.

4. In addition, I have worked with economics professors from Sam Houston State University on the development of methodologies and traffic and population statistical baselines to study issues related to police racial profiling. I have given presentations at professional meetings and to police agency organizations, including PERF, on issues related to the statistical analysis of police racial profiling and use of force. I have also served as an expert witness for Plaintiffs and Defendants in legal cases involving allegations of police racial profiling. In Regina Kelly et al. v. John Paschall et al., in the United States District Court for the Western District of Texas, Waco Division, I served as a statistical expert witness for the Plaintiffs. In this case the Plaintiffs alleged that The South-Central Texas Narcotics Task Force, which was a group of police agencies set up for drug policing in Limestone and Robertson counties, were racially profiling African-Americans. In this case, I analyzed incident level data, police agency level data, and numerous population and crime databases to study the Plaintiffs' allegations of police racial profiling.

5. In addition to my work involving police agencies, I have served as an expert witness and consultant in federal and state court on statistical issues in numerous employment discrimination cases involving terminations, promotions, compensation, and hiring. I have provided expert reports, deposition testimony, and trial testimony on statistical issues in employment matters in states including Mississippi,

Alabama, Louisiana, Georgia, Florida, Texas, Oklahoma, California, New Mexico, Arizona, Washington, Illinois, Iowa, Missouri, Massachusetts, New Jersey, New York, and Pennsylvania. I have also presented research to numerous academic and professional groups on the issues related to the statistical analysis of discrimination in employment.

6. In addition, I have also held teaching positions in the Department of Economics at The University of Texas at Austin, the Red McCombs School of Business at The University of Texas at Austin, and the College of Business Administration at Sam Houston State University. In my teaching positions, I have taught dozens of courses in statistics and its application to economic problems including discrimination. Among my courses at the University of Texas at Austin I designed and taught a semester length upper division course devoted to the study of economic and statistical models of racial and gender discrimination.

7. I hold a Ph.D. in Economics from the University of Iowa ('95) and a B.A. in Economics from The University of Texas at Austin ('90). Prior to obtaining my Ph.D., I also earned an officer's commission in the U.S. Army Field Artillery through UT-Austin Army R.O.T.C. and served stateside during Operation Desert Storm. My full curriculum vitae is attached to this report as Exhibit "A".

8. In brief, it is my opinion that Dr. Bryan Ricchetti's analysis is severely flawed and scientifically unreliable. As will be discussed in the following sections of this report, Dr. Ricchetti's underlying data is flawed and inaccurate. Dr. Ricchetti's computer coding of the geographical location of MCSD traffic roadblocks is inaccurate throughout

a substantial portion, and possibly throughout all, of the data he uses to perform his statistical analysis. The fundamental inaccuracies in his data undermine the reliability of his purported statistical findings and make it difficult, if not impossible, to determine the rate of error associated with his statistical analysis.

9. The problems with Dr. Ricchetti's faulty data are compounded by the unsound methodology that he employs throughout his analysis. Dr. Ricchetti's racial composition of the different geographical areas of Madison County is ad hoc and unsupported by sound reasoning. In contrast to Dr. Ricchetti's assumptions, the demographic composition of the geographical areas varies substantially within the census tracts he uses in his analysis of MCSD traffic roadblocks.

10. Dr. Ricchetti's use of census tract data in this case is simply unsound. The use of U.S. Census population data is not a generally accepted method for studying traffic enforcement and has been the subject of intense scrutiny for decades in the area of police racial profiling research. The methodology that Dr. Ricchetti is attempting to use in his study of MCSD traffic roadblocks has been effectively debunked for a period of time.

11. Dr. Ricchetti's research, even taken at face value (which should not be done, due to unreliability) clearly indicates that DUI activity and not race, is the key factor in MCSD traffic roadblock location placement. His statistical models clearly show that the number of DUI arrests in a census tract, and not the race of the residents in the census, determines the number of traffic roadblocks in a given census tract. In fact, Dr. Ricchetti essentially concedes this point in his deposition testimony.

12. A closer examination of Dr. Ricchetti's tabulations shows that there is in fact no statistically significant difference between the number of traffic roadblocks in low and high African-American population areas. As will be discussed, Dr. Ricchetti's comparisons of the roadblocks in low and high African-American population are not statistically significant. Incredibly, in contrast to generally accepted practices, Dr. Ricchetti does not present, and does not even appear to perform, tests of the statistical significance of his numerical comparisons of the average number of traffic roadblocks. The purported difference between the average number of traffic roadblocks in low and high African-American population areas is consistent with an outcome that could have been generated by sheer chance by a racially unbiased traffic roadblock location process.

13. Further, accounting for even a small number of the errors in Dr. Ricchetti's methodologies shows that the racial composition of the census tract in which the traffic roadblock is placed is not a statistically significant factor in MCSD's roadblock placement decision. Dr. Ricchetti's defective theoretical model, which relies on census tract data for the race of residents in Madison County, does not account for the racial demographics of the actual Madison County motoring public driving through MCSD actual traffic roadblocks. Dr. Ricchetti compounds the flaws in his analysis by accounting for irrelevant factors, such as the average unemployment rate and household income of the individuals living in the census tract. Dr. Ricchetti provides no professional, academic or even case documents, to support his theory that demographic and income factors associated with the race of the residents is a

determining factor in MCSD decisions, or any police agency for that matter, on where to place traffic roadblocks.

14. My analysis is discussed in more detail in the following sections of this report. The case-related documents, treatises, and other information used to prepare this analysis are listed in Exhibit A, footnotes, and in the text of this report. I respectfully reserve the right to make changes to this report.

Overview of Dr. Ricchetti's traffic roadblock analysis methodology

15. In his March 13, 2018 expert report, Dr. Ricchetti attempts to perform two separate statistical analyses concerning police racial bias and traffic roadblock placement in Madison County. In his first analysis, he compares the number of traffic roadblocks in geographical areas of Madison County that have a low African-American resident population percentage to the number of traffic roadblocks in geographical areas of Madison County that have a high African-American resident population percentage. In his second analysis, he attempts to estimate the correlation between the number of traffic roadblocks in Madison County geographical areas and the African-American population percentage in those geographical areas.

16. According to Dr. Ricchetti's resume and deposition testimony, Dr. Ricchetti is an economist who performs research on antitrust and employment issues. Dr. Ricchetti's resume indicates that he has presented on antitrust and product market issues and has written on subjects including pricing regulations in the dairy industry and applying statistics to the assessment of market definition and market power. However, he freely admits his lack of any experience with analyses in the law enforcement

context. While statistical analyses may sometimes be a helpful tool, it must be used in context to know what is relevant or not. If the data is used out of context, even if accurate, that statistical analysis is not reliable.

17. In Dr. Ricchetti's first analysis of MCSD traffic roadblock placement, he reports to find that more MCSD traffic roadblocks are placed in areas with a high African-American resident population percentage than in areas where there is a low African-American resident population percentage. In his analysis, Dr. Ricchetti defines a 'low African-American resident population percentage' as one where 28.0% or less of the population living in the geographical area identifies as African-American. Dr. Ricchetti defines a 'high African-American resident population percentage' as one where 46.2% or more of the population living in the geographical area identifies as African-American. Dr. Ricchetti provides no basis for why he chose these percentages. And in fact, his data proves the opposite of what he says. An examination of Exhibit 1 of his report shows that more roadblocks are performed in census tracts that are majority white than the number in tracts that are majority black when a 50% threshold is used for the white/black demarcation (as opposed to Dr. Ricchetti's arbitrary percentages), and that more Whites are subject to roadblocks when the actual population of census tracts are added to his chart. In short, Dr. Ricchetti's first analysis is severely flawed (for the reasons explained below), but even if taken at face value, only shows that there is no basis for his assertion that there are more roadblocks in "Black" as opposed to "White" census tracts.

18. Just as fundamental, Dr. Ricchetti does not provide professional or academic research literature that discusses how the residential population relates to the driving traffic population in that area. Dr. Ricchetti also does not identify any professional or academic research literature that he relied upon to construct his racial categorizations. He also does not identify which racial grouping that Madison County geographical areas have an African-American population that lies between 28.0% and 46.2% should be placed.

19. In his second analysis, Dr. Ricchetti reports that the number of MCSD traffic roadblocks in a geographical area increases as the percentage of African-Americans living in that geographical area increases. He finds that a one point increase in the African-American population percentage is correlated with an increase of approximately 0.06 traffic roadblocks in a year. Even if taken at face value, which should not be done, Dr. Ricchetti's conclusion is that if the African-American population of a census tract increased by 1% per year, then there would be 0.06 more roadblocks in that tract per year. According to Dr. Ricchetti's model, it would take sixteen (16) years for there to be an additional roadblock in that given tract.¹ This *de minimis* figure is hardly a credible basis for finding that the MCSD has a policy of targeting African-American areas of Madison County.

20. Dr. Ricchetti further finds that, regardless of race, an increase of one DUI arrest, in a tract is correlated with a 1.22 increase in roadblocks, which is more than

¹ $1/0.06 = 16.7$

twenty (20) times the amount for race.² He himself admits that DUI arrests are the predominate driver of roadblock locations according to his analysis.

21. In both analyses, Dr. Ricchetti utilizes geographical areas as defined by the U.S. Census Bureau. The U.S. Census Bureau defined geographical areas that Dr. Ricchetti uses in his analysis, which are referred to as 'census tracts', vary in terms of residential density, commercial development, retail activity, and physical size, all factors which Dr. Ricchetti admits he has no knowledge of. Some of the census tracts that Dr. Ricchetti uses cover over 188 square miles while others cover less than one square mile. The demographic composition of the geographical areas used by Dr. Ricchetti also vary substantially within the census tracts he uses in his analysis of MCSD traffic roadblocks.

22. As will be discussed, Dr. Ricchetti's analysis is flawed on multiple levels. Accounting for even a small number of the flaws in his analyses causes Dr. Ricchetti's purported findings and inferences of police racial bias to disappear. In fact, Dr. Ricchetti's data, statistical tabulations, and deposition testimony indicate that MCSD traffic roadblock placement is correlated with DUI activity, regardless of race. These issues are discussed in the following sections of this report.

Dr. Ricchetti's traffic roadblock data is fundamentally flawed

23. Dr. Ricchetti's analysis is flawed at the most fundamental level: the data. Dr. Ricchetti's computer coding of the geographical location of MCSD traffic roadblocks is inaccurate throughout a substantial portion, and possibly throughout all, of

² In his model, Dr. Ricchetti's coefficient on the DUI variable is, 1.22. Dr. Ricchetti's coefficient on the race variable is 0.06. $1.22 \div .06 = 20.33$.

the data he uses to perform his statistical analysis. The fundamental inaccuracies in his data undermine the reliability of his purported statistical findings and make it difficult, if not impossible, to determine the rate of error associated with his statistical analysis.

24. Specifically, according to his report and deposition testimony, Dr. Ricchetti converted the MCSD traffic roadblock address information that he provided into longitude and latitude geolocation coordinates.³ Dr. Ricchetti then used the geolocation coordinates that he constructed to map each unique traffic roadblock to a specific census tract. Dr. Ricchetti used U.S. Census census tract information to divide Madison County into low and high African-American residential population areas. Dr. Ricchetti also assembles data on racial composition, population, income, and unemployment for each census tract using the U.S. Census data.

25. Clearly, the accuracy of the geolocation coding of MCSD traffic roadblocks is crucial to the reliability of Dr. Ricchetti's statistical analyses. If the geolocation coding of the MCSD traffic roadblocks in his study is inaccurate, then Dr. Ricchetti's assignment of the roadblocks to low and high African-American Population areas is unreliable and statistically uninformative. Similarly, the census level information that Dr. Ricchetti assembles relies on the correct geolocation determination of each roadblock. If the roadblock address is inaccurate in instances then Dr. Ricchetti's census information regarding the population, income and unemployment in that area will be misidentified and unreliable.

³ See April 6, 2018 Deposition Testimony Transcript of Bryan Ricchetti, Ph.D., Pg. 180, Ln. 14 - 20

"Q: And what I was asking you again what census tract is it assigned to. When you get the intersection description how do you know which road it's on, the roadblock?" "A: So we assume the roadblock is in the -- at a specific longitude and latitude of the address from ArcGIS."

26. Dr. Ricchetti's computer coding of the geographical location of MCSD traffic roadblocks is in fact inaccurate. Dr. Ricchetti does not provide documentation, professional treatises, or academic foundation for the methodology that he used to construct his underlying traffic roadblock geolocation data. For instance, most of the traffic roadblocks that he created exact geolocation data for in analysis did not actually have exact underlying address information associated with them. It is my understanding that it is MCSD policy to provide traffic roadblock location descriptions in such a way that aids police officer's ability to respond and navigate efficiently to that specific location. Accordingly, MCSD personnel may describe a traffic roadblock in general terms, such as the intersection of two roads, even if the location of the actual roadblock is not located at that actual intersection.

27. The Computer-Aided Dispatch (CAD) report is MCSD's database of calls for dispatch, and contains a description of the call for dispatch, the date and time the call was received, the time the officers arrived on scene, the time the officers cleared the scene, and the approximate location of the activity. For example, the CAD Report indicates that there was a roadblock in Ridgeland on Pine Knoll Drive on November 6, 2014, but no exact address is given. In this instance, Dr. Ricchetti somehow created an exact geolocation for this location without having exact underlying address location information. Dr. Ricchetti created geolocation data in numerous other roadblock instances. Dr. Ricchetti provided no documentation or support for the underlying methodology that he used to assign longitude and latitude geolocation coordinates in these types of instances, or for his data in general. It is not clear from Dr.

Ricchetti's deposition testimony that he considered this issue when he created his geolocation data in this case.⁴ Dr. Ricchetti's testimony indicates that when he did have exact address location data that his computer program, apparently by default, placed the MCSD traffic roadblock in the middle of road where ever that was located.⁵

28. Even a cursory examination of Dr. Ricchetti's data shows that his geocoding methodology places MCSD traffic roadblocks in physical locations that are impractical, and in some instances, impossible. For instance, consider the March 30, 2013 roadblock from the CAD report, which has longitude and latitude geolocation coordinates in Dr. Ricchetti's data. The underlying location data identifies it as 32.421438, -90.106353. A quick plot of these coordinates utilizing the publically available and widely utilized mapping software Google Maps indicates that these geolocation coordinates point to a physical location that is in the middle of the intersection of Old Canton Rd. and Rice Rd., which are both at least four lanes wide at the intersection. It is my understanding that MCSD does not generally place roadblocks in the middle of an intersection; such would endanger officers and the public.⁶ Instead, when an intersection is used to identify the location, which is almost always the case, the roadblock will be on one of the four (4) approaches to the intersection and may vary in distance from the intersection.⁷

⁴ See April 6, 2018 Deposition Testimony Transcript of Bryan Ricchetti, Ph.D., Pg. 168 Ln. 4-25 - Pg. 169 Ln. 1-5, Pg. 170 Ln. 21-25 - Pg. 171 Ln. 1-9, Pg. 175 Ln. 24-25 - Pg. 176 Ln. 1-25, Pg. 178 Ln. 5 - 14.

⁵ See April 6, 2018 Deposition Testimony Transcript of Bryan Ricchetti, Ph.D., Pg. 176 Ln. 10-25

⁶ See expert report of Mr. Mark S. Dunston, dated May 1, 2018, Pg. 15-16

⁷ See Declaration of Mark Sandridge

29. Additionally, consider the June 25, 2015 roadblock from the CAD report, which has longitude and latitude geolocation coordinates in Dr. Ricchetti's data. The underlying location data identifies it as 32.68291, -90.15925. A quick plot of these coordinates indicates that these geolocation coordinates point to a physical location that is in the middle of the woods alongside Big Black River. There are no roads near the vicinity of these coordinates assigned by Dr. Ricchetti. These types of problems are evident throughout Dr. Ricchetti's data.

30. The accuracy of Dr. Ricchetti's geolocation data is critical to the reliability of his statistical analysis. For instance, consider the November 8, 2013 roadblock, whose location is listed as "Livingston Vernon Rd / Stokes" in Dr. Ricchetti's CAD report data. There was no exact address listed for this location according to Dr. Ricchetti's data files. Even though there is no exact address information for this roadblock location, Dr. Ricchetti's geolocates this roadblock as being set up in the middle of the intersection of Livingston Vernon Road and Stokes Road. Dr. Ricchetti identifies this MCSD traffic roadblock as a being in a 'High African-American Population' area in his analysis.

31. This example illustrates the problems associated with Dr. Ricchetti's lack of geocoding precision. Dr. Ricchetti's determination of the racial composition of hinges on where this roadblock is actually placed. If for example, the actual roadblock was in fact not in the middle of the intersection as assumed by Dr. Ricchetti, the racial composition could differ from what he indicates in his report. For instance, if this roadblock was actually at the southern approach to the Livingston Vernon and Stokes

Road intersection, and not in the middle of the road as arbitrarily assumed by Dr. Ricchetti, this MCSD traffic roadblock would have been placed in a 'Low African-American Population Percentage' census tract and not a 'High African-American Population Percentage' census tract as Dr. Ricchetti does in his report. This error will in turn result in the number of roadblocks that he assigns to the different census tracts to be in error.

32. Overall, the fundamental unreliability of the geolocation data that Dr. Ricchetti constructs makes it difficult, if not impossible, to determine the level and direction of the errors that his faulty methodology introduces into his analysis. In some instances, he will erroneously assign MCSD traffic roadblocks to High African-American population areas while in other instances his methodology will create the opposite error. It is unacceptable and unreasonable to assume that his errors will 'wash out' in the end. Dr. Ricchetti does not perform statistical tests to determine what impact these types of errors may have on his analysis and simply assumes that this type of 'data noise' will not have an impact on his analysis.⁸

Dr. Ricchetti's underlying statistical methodology is scientifically unsound

33. The problems with Dr. Ricchetti's faulty data are compounded by the unsound methodology that he employs throughout his analysis. As described previously, Dr. Ricchetti attempts to perform two separate statistical analyses concerning police racial bias and MCSD traffic roadblock placement. In his first analysis, he compares the number of traffic roadblocks in geographical areas of

⁸ See April 6, 2018 Deposition Testimony Transcript of Bryan Ricchetti, Ph.D., Pg. 176, Ln. 5.

Madison County that have a low African-American resident population percentage to the number of traffic roadblocks in geographical areas of Madison County that have a high African-American resident population percentage. In his second analysis, using a statistical technique known as regression, he attempts to estimate the correlation between the number of MCSD traffic roadblocks in Madison County geographical areas and the African-American population percentage in those geographical areas. The methodology and reasoning underlying both of his analyses are unsound.

34. Dr. Ricchetti's classification of low and high African-American population is ad hoc and unsupported by sound reasoning. In his analysis, Dr. Ricchetti defines a 'low African-American resident population percentage' as one where 28.0% or less of the population living in the geographical area identifies as African-American while a 'high African-American resident population percentage' as one where 46.2% or more identify as African-American. According to his report and deposition testimony, Dr. Ricchetti arrives at his classification of Madison County census tracts into low and high African-American population areas by simply ordering the 21 census tracts in Madison County by the census tract average African-American population percentage and then arbitrarily dividing the 21 census tracts into two approximately equal sized groups of census tracts.

35. The first grouping of 11 census tracts, which Dr. Ricchetti arbitrarily labels as low African-American population, have average African-American population percentages of up to 28.0%. The second grouping of 10 census tracts, which Dr. Ricchetti arbitrarily labels as high African-American population, have average

African-American populations greater than 46.2%. The African-American population percentage is less than 50.0% of the census tract in three (3) of the 10 census tracts in the grouping that Dr. Ricchetti classifies as high African-American population percentage.⁹ He provides no sound reason as to why police racial bias would be expected to appear when a census tract achieves an African-American population of 46.2% and not some other level. Dr. Ricchetti provides no studies, research or professional treaties to support the methodology that he uses to classify Madison County into different racial groupings. In fact, as discussed later in this section, his methodology is not consistent with generally accepted methodology in police racial profiling research.

36. In any event, Dr. Ricchetti's arbitrary racial definitions have a significant effect on his purported findings. If Dr. Ricchetti would have utilized more conventional reasoning he would have found that there was little to no difference between the number of MCSD traffic roadblocks in low and high African-American population areas. For instance, Dr. Ricchetti purports to find that there are 28 roadblocks per 1,000 people in high African-American population areas and 14 roadblocks per 1,000 people in low African-American population areas. Dr. Ricchetti's findings are impacted by his arbitrarily selected racial population groupings. I am not aware of law enforcement research literature that supports Dr. Ricchetti's assumption that traffic enforcement of DUI activity is driven by the residential population as opposed to traffic and drivers on the road.

⁹ See April 6, 2018 Deposition Testimony Transcript of Bryan Ricchetti, Ph.D., Pg. 81, Ln. 6 -12.

37. Even if Dr. Ricchetti would have even liberally defined a 'high African-American population area' as a census tract where the African-American population is greater than 50.0%, and not arbitrarily and inappropriately weighted by the residential population, he would have found that there was not a higher number of roadblocks in high African-American areas. In fact, if he would have adopted a more generally accepted statistical approach such as this, he would have found that the number of roadblocks in the low African-American areas actually exceeded the number of roadblocks in high African-American areas. According to his data, he would have found that there were 1104 roadblocks in low African-American areas and 900 roadblocks in high African-American areas had he not utilized his inappropriate assumptions.

38. Further, Dr. Ricchetti's explicit and ad hoc assumption that police racial bias appears when a census tract achieves an African-American population of 46.2% is troubling and inconsistent with generally accepted research literature on police racial profiling and bias. In contrast to Dr. Ricchetti's approach, police racial profiling and bias research of traffic enforcement generally attempts to compare the prevalence of some traffic enforcement activity, such as traffic stops, to the relevant driving population at risk of being stopped by the police agency being studied. For instance, in the well known study "Methods for Assessing Racially Biased Policing", the researchers used a number of different measures to compare the racial composition of the police traffic stops to the racial composition of the drivers on the road.¹⁰ It is my understanding

¹⁰ "Methods for Assessing Racially Biased Policing", Ridgeway and MacDonald (2010) describes and critiques multiple benchmarking methods that have been used throughout the country to assess potential racially biased

that Courts have also recognized the importance of accounting for actual driving population when conducting analyses of allegations of police racial bias. I understand that when there is no attempt, or an unreliable attempt, to correlate the relevant driving population to traffic enforcement activity, courts have deemed the analysis as unreliable.

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39. In contrast to Dr. Ricchetti's approach, it is generally acknowledged in the police racial profiling research literature that the residential population in a given area is not an appropriate measure of the driving population in these types of settings. Further, these studies generally do not indicate that police racial profiling bias can be expected to occur at some specific racial population percentage level as Dr. Ricchetti assumes in his analysis. Dr. Ricchetti appears to be developing some type of new police racial bias theory or is applying the existing racial profiling literature in some novel and untested manner.

40. Dr. Ricchetti's deposition testimony indicates that he independently developed the statistical factors he included in his model and that the factors were not the actual factors considered by MCSD when determining where to place DUI roadblocks. Dr. Ricchetti testified that he has not previously performed research on law enforcement issues and was not familiar with any studies that utilized his statistical methodology. Dr. Ricchetti testified that he thought an officer's decision on where to place a traffic roadblock was analogous to the decision to hire or fire an individual.¹² In

policing. See also, "Racial Disparities in Texas Department of Public Safety Traffic Stops, 2002-2014", Baumgartner, Jones, Zaconet, Wilson, and Krishnamurthy (2015).

¹¹ See for example, *U.S. v. Johnson*, 122 F. Supp. 3d 272 (2015).

¹² See for example, April 6, 2018 Deposition of Bryan Ricchetti, Pg. 17, Ln. 11 - Pg. 17, Ln. 21.

my 19 years of professional experience with working in this area of research, I have not seen police racial bias analysis performed in the manner that Dr. Ricchetti does in his report.

41. Further, even if Dr. Ricchetti's methodology and data were sound, which they are not, his defective application of his methodology further undermines the reliability of his statistical analysis. For instance, there are numerous instances where the MCSD traffic roadblocks in Dr. Ricchetti's data effectively straddle two different census tracts. In these instances, Dr. Ricchetti appears to arbitrarily assign the roadblock to one of the contiguous census tracts. When asked at his deposition about this issue, Dr. Ricchetti did not appear to have realized that these instances were evident in his data.¹³

42. For example, a closer look at Dr. Ricchetti's data shows that the November 8, 2013 roadblock on Stokes Road in Dr. Ricchetti's data essentially straddles census tract 303.02 to the north of the road and census tract 304 to the south of the road. Census tract 303.02 is in a high African-American population area and census tract 304 is in a low African-American population area according to Dr. Ricchetti's analysis. Given that the roadblock straddles both census tract areas, it is reasonable to expect that traffic on the road that passes through the roadblock would reflect in some way the demographics from both the low and high African-American areas. Dr. Ricchetti assumes that 100% of the traffic that passes through this roadblock is from census tract 303.02 and places this roadblock in the high African-American area.

¹³ See April 6, 2018 Deposition of Bryan Ricchetti, Ph.D., Pg.172 Ln. 16-25 - Pg. 173 Ln. 1-15.

43. The census tract demographic data that Dr. Ricchetti uses is simply inappropriate in the current setting. The demographic composition of the geographical areas used by Dr. Ricchetti varies substantially **within** the census tracts he uses in his analysis of MCSD traffic roadblocks. That is, the demographics of Madison County's census tracts changes as you move within a given census tract. Dr. Ricchetti's assumption that the driving population reflects the average population within a given census tract is simply not valid.¹⁴

44. For instance, consider census tract 303.02 in Dr. Ricchetti's data. This census tract is in the south-west corner of Madison County and includes the towns of Flora and Kearney Park. The average African-American population percentage in this census tract is 49.3% and is classified as a census tract with a high African-American population percentage by Dr. Ricchetti. However, there is substantial variation in the actual racial demographics within this census tract that clearly undermines the validity of Dr. Ricchetti's racial classifications.

45. In fact, this census tract is actually composed of four subgroups, referred to as 'Census Block Groups' by the U.S. Census. The percentage of the population that is African-American varies substantially as you move with the census tract. Figure 1 shows a map of the census block groups within census tract 303.02. As the figure shows, although census tract 303.02 has an average African-American population of 49.3%, the actual percentage of African-American residents varies from 19.6% to 77.8% as you move throughout the census tract. Census block group 1,

¹⁴ Note his assumptions are particularly troubling given that Dr. Ricchetti uses a five year average as a proxy for who would pass through the MCSD roadblocks.

which is in the western part of the census tract, has a population that is 19.6% African-American. In comparison, census block group 4, which is in the northern region of the census tract, has a population percentage of 77.8%. Dr. Ricchetti's assumption that the driving population that is subject to the traffic will mirror the residential population in a census tract is simply not correct.

46. Figures 2, 3, and 4 show maps of the individual census blocks within the census tracts in Dr. Ricchetti's analysis. Census blocks are the smallest geographic areas for which the Census Bureau collects census data, and block groups are the next level above census blocks in the geographic hierarchy. As this map shows, there is substantial variation in racial composition across the census blocks within the census tracts in his analysis. In some census tracts where Dr. Ricchetti has indicated that there is a high population of African-American residents, the actual census tract is not highly populated by African-Americans across the entire census tract. Instead, African-American residents may only reside in one area of the entire census tract. In any event, the location of the roadblocks within the census tract is an important factor and cannot be assumed away, and not accounted for, as Dr. Ricchetti does in his analysis.¹⁵ Not accounting for this factor further undercuts the reliability of his analyses.

¹⁵ See April 6, 2018 Deposition of Bryan Ricchetti, Ph.D., Pg. 83 Ln. 2-15.

"Q: Yeah. I mean, it basically says, and I'm drawing a circle here in the air, everyone within this category together is whatever percentage of the racial distribution? It doesn't account for local variations on the north side, the south side, the east side --" "A: I agree with that, yeah. It's a census tract level analysis, and there may be variation within the census tract."

Residential population is not a reliable measure of a driving population

47. Even if there were not substantial variation in the African-American population within the different census tracts, which there is, Dr. Ricchetti's use of census tract data would still be unsound. The use of U.S. Census population data is not a generally accepted method for studying traffic enforcement and has been the subject of intense scrutiny for decades in the area of police racial profiling research. It is generally recognized that the driving population on a given road can vary from the residential population in the area of the road for any number of reasons. Commercial and retail activity frequently draws individuals onto area roads that are demographically different from the persons who live in the residences surrounding the roads. The problem with Dr. Ricchetti's use of residential census data is particularly troubling. The methodology that Dr. Ricchetti is attempting to use in his study of MCSD traffic roadblocks has been effectively debunked for a period of time.¹⁶

48. The inappropriateness of Dr. Ricchetti's use of census population data is enhanced since he is trying to determine the demographics of the motorists who are traveling through specific traffic roadblocks in a precise location on a road within a given census tract over a five year time span. As Dr. Ricchetti indicates in his report and in his deposition testimony, traffic roadblocks are designed to enforce specific traffic laws, such as drunk driving, for driving motorists.¹⁷ Accordingly, factors such as traffic

¹⁶ See for example and the references within: Annual Contact Report, 2016, The Arlington Police Department, Del Carmen (2016), Methods for Assessing Racially Biased Policing, Ridgeway and MacDonald (2010).

¹⁷ See April 6, 2018 Deposition of Bryan Ricchetti, Ph.D., Pg. 52, Ln. 9-25, Pg. 53, Ln. 1-6:

flow, commercial and retail development, and bar and restaurant activity impact which motorists, and the underlying demographics, actually travel through specific traffic roadblock location at a given point of time. Even though Dr. Ricchetti admits at his deposition that the driving traffic on the road determines who is actually impacted by the roadblock, for whatever reasons he still does not account for these types of factors in his statistical analyses.¹⁸

49. For instance, the bar and restaurant activity in a given area is a fundamental factor that Dr. Ricchetti does not account for in his study of traffic roadblocks. It is clear from the court records, including deposition testimony from MCSD personnel, and Dr. Ricchetti's own deposition testimony, that nearly all, if not all, of the traffic roadblocks at issue in this case are DUI enforcement roadblocks.^{19 20 21 22}

"Q: What did you do to get ready to familiarize yourself with the decision-making process? For your project here of analyzing roadblocks" "A: I would say it was a mix of qualitative and quantitative cite. There was statements in the record from the defendants about the factors they considered in placing roadblocks. There was the guidelines, the sobriety checkpoint guidelines, which laid out factors. And then there's -- in the data you're able to kind of test whether those factors are important. And so what was clear in the documents was that things like regulating DUI behavior seemed to be a focus of these roadblocks and that generally seems to be an important aspect of roadblocks, and the data then sort of confirmed that that variable, for example, was highly correlated and related to the placement of roadblocks."

¹⁸ See April 6, 2018 Deposition of Bryan Ricchetti, Ph.D., Pg. 90, Ln. 24-25 - Pg. 91, Ln. 1-12

"Q: But, again, I'm trying to focus on the population at risk of being caught in a roadblock 1 It is only the drivers on the road." MR. YOUNGWOOD: "Objection; form." THE WITNESS: "Once --" BY MR. NOBILE: "Q: How else would you be caught by a roadblock?" MR. YOUNGWOOD: "You're cutting him off." MR. ROSS: "Let him answer." THE WITNESS: "Yes, once there's a roadblock in place I agree that the people who would be affected by it would be whoever happens to experience the roadblock."

¹⁹ See April 6, 2018 Deposition of Bryan Ricchetti, Ph.D., Pg. 59, Ln. 3-9.

"Q: But the defendants, you'll agree with me, didn't say anything about rates of DUI citations or anything like that, they said they were -- what is your understanding about what the defendants said in the record?" "A: My understanding is that regulating DUIs is a goal of the roadblocks."

²⁰ See April 6, 2018 Deposition of Bryan Ricchetti, Ph.D., Pg. 57, Ln. 4-19

"Q Did you do any research in trying to ascertain different factors that go into deciding where to place a roadblock?" MR. YOUNGWOOD: "Objection to form." THE WITNESS: "Well, you know, one fact in my model was just that the amount of explanatory power of the DUI frequencies was very large statistically, and so that was quite striking in the data and it seems -- and it was very consistent with what the documents and what the defendants described as the --

It is reasonable to expect that there is likely a relationship between the location of bar and restaurants in Madison County and the location of MCSD traffic roadblocks that is independent of the race of the individuals in the surrounding residential areas.

50. Dr. Ricchetti's own data shows that there is in fact a relationship between the location of bars and restaurants in Madison County and MCSD traffic roadblock locations. For example, consider roadblocks placed in the Ridgeland area in the Southeast corner of Madison County. A tabulation of the MCSD traffic roadblocks in this area show that the majority of the roadblocks are in close geographic proximity of a bar or restaurant.

51. For example, in Ridgeland census tract 301.07 there were 163 roadblocks shown in Dr. Ricchetti's data over the 2012-2017 time period. On average, these roadblocks were placed within one half mile of the bars and restaurants in this area. Further, 96.0% of these MCSD traffic roadblocks were conducted at night, between the hours of 7 PM and 3 AM. The timing of these roadblocks is consistent with DUI activity and is after typical residential commute travel hours.²³ It is reasonable to expect that the demographics of the individuals who travel on these roads and through these roadblocks will reflect at least in part, if not in whole, the demographics of the bar

as a key factor in placement. So like that's -- that certainly suggests to me that those are consistent with the statements from the defendants that those are a key aspect of the roadblocks, they're trying to regulate DUIs."

²¹ Declaration of Mark Sandridge

²² See November 14, 2017 Deposition of Mark Sandridge, Pg. 29, Ln. 10-21

"Q: So at the present are you responsible for selecting the locations of roadblocks that the DUI unit conducts?" "A: I trained a guy that's on my unit to know what we expect and what we want to do and he now picks those locations."
 "Q: Who is that?" "A: Rylon Thompson." "Q: And you said earlier that other divisions of the sheriff's department also conduct roadblocks. Is that right?" "A: Very rarely, but mainly only on the holidays."

²³ 2009 National Household Travel Survey. *Summary of Travel Trends*. U.S. Department of Transportation Federal Highway Administration. (2009)

and restaurant patrons during these hours. The demographics of the bar and restaurant patrons during these hours may differ from the demographics of the residents who live in proximity of the area. These types of statistical patterns, which Dr. Ricchetti does not account for, are evident throughout the traffic roadblock data.

52. Traffic and roadblocks in and around recreational and boating areas is another factor that Dr. Ricchetti does not consider in his analysis. Similar to bar and restaurant locations, it is reasonable to expect that there is likely a relationship between the location of recreational and boating areas in Madison County and the location of MCSD traffic roadblocks that is independent of the race of the individuals in the surrounding residential areas. Also as with traffic emanating from bars and restaurants, it is reasonable to expect that the demographics of the individuals who travel on roads heading to and from recreational and boating areas will reflect the demographics of the individuals who frequent those recreational areas.

53. In short, Dr. Ricchetti's use of census tract data is unsound. The use of U.S. Census population data is not a generally accepted method for studying traffic enforcement activity and has been the subject of intense scrutiny and criticism for decades in the area of police racial profiling and bias research.

DUI activity, and not race, is the key factor in traffic roadblock location placement

54. Dr. Ricchetti's analysis is flawed on multiple levels as was discussed and will continued to be discussed in the next section of this report. However, even taking Dr. Ricchetti's analysis as correct, his report clearly indicates that DUI activity and

not race, is the key factor in MCSD traffic roadblock location placement. In fact, Dr. Ricchetti essentially concedes this point in his deposition testimony.

Q: Did you do any research in trying to ascertain different factors that go into deciding where to place a roadblock?

MR. YOUNGWOOD: Objection to form.

THE WITNESS: Well, you know, one fact in my model was just that the amount of explanatory power of the DUI frequencies was very large statistically, and so that was quite striking in the data and it seems -- and it was very consistent with what the documents and what the defendants described as the -- as a key factor in placement. So like that's -- that certainly suggests to me that those are consistent with the statements from the defendants that those are a key aspect of the roadblocks, they're trying to regulate DUIs.²⁴

55. In his second analysis, Dr. Ricchetti reports that the number of MCSD traffic roadblocks in a geographical area increases as the percentage of African-Americans living in that geographical area increases. He finds that a one point increase in the African-American population percentage is correlated with an increase of approximately 0.06 traffic roadblocks in a year. Dr. Ricchetti further finds that, regardless of race, an increase of one DUI arrest in a given Madison County geographical area is correlated with an increase in approximately 1.22 traffic roadblocks in that area.

56. Even if taken at face value, which should not be done, Dr. Ricchetti's conclusion is that if the African-American population of a census tract increased by 1% per year, then there would be 0.06 more roadblocks in that tract per year. Accordingly,

²⁴ See April 6, 2018 Deposition of Bryan Ricchetti, Ph.D., Pg. 57 Ln. 4-19

under Dr. Ricchetti's model it would take approximately sixteen (16) years for there to be an additional roadblock in that tract.²⁵ This *de minimis* figure is hardly a credible basis for finding that the MCSD has a policy of concentrating roadblocks in African-American areas of Madison County.

57. In contrast, Dr. Ricchetti further finds that, regardless of race, an increase of one DUI arrest in a tract is correlated with a 1.22 increase in roadblocks. Even an approximate comparison of these two numbers shows that the impact of DUI activity in a census tract is many times larger than that of race. As mentioned above, Dr. Ricchetti himself admits that DUI arrests are the predominate driver of roadblock locations according to his analysis.

58. Examining the number of traffic roadblocks and DUI activity during specific points in time further illustrates this fact. It my understanding that MCSD receives grant funding from Mississippi Office of Highway Safety (MOHS) in its efforts to reduce the incidents of drunk driving and to assist with cost of establishing DUI traffic roadblocks.²⁶ It is my understanding that the grant funding is subject to periodic renewal and is contingent on satisfactory achievement of DUI enforcement. Even a cursory look at the traffic roadblock and CAD data shows that the DUI activity in a geographical area during a specific time period is correlated with an increased number of traffic roadblocks in the geographical area in later time periods.

²⁵ $1/0.06 = 16.7$

²⁶ FY16 Subgrant Application Mississippi Office of Highway Safety for the Madison County Sheriff's Department, October 1, 2015.

59. For example, consider the DUI activity in census tract 301.04 and census tract 304 over the three month time period from October 1, 2014 to December 31, 2014. In census tract 301.04 over this three month time period there were no DUIs stemming from traffic stops. This census tract runs from S Pear Orchard Road to Old Canton Road. In this census tract, there were also no DUI traffic roadblocks during this time period. In comparison, in census tract 304 over the same time period there were no traffic roadblocks but there were nine (9) DUIs stemming from traffic stops. This census tract is located approximately in Canton and Flora.

60. As would be reasonably expected, there were no DUI traffic roadblocks established in subsequent time periods in the census tract that had no DUI activity stemming from traffic stops in prior time periods. Over the subsequent three months, January 1, 2015 to March 31, 2015 there were no MCSD traffic roadblocks established in the low DUI census tract 301.04. In comparison, also as would be expected, there were DUI traffic roadblocks established in subsequent time periods in the census tract that had high DUI activity stemming from traffic stops in prior time periods. Over the subsequent three months, January 1, 2015 to March 31, 2015 there were two MCSD traffic roadblocks established in the high DUI census tract 304.

61. This roadblock pattern is independent of the race of the Madison County residents in the census tract and is evident throughout the MCSD traffic roadblock and CAD data. In any event, Dr. Ricchetti fails to account for these clear and important factors in his analysis. As discussed in the next sections, even fixing a small

number of the flaws in Dr. Ricchetti's analysis further illustrate the fact that race is not a factor in the placement of MCSD traffic roadblocks.

Race is not a factor in the placement of MCSD traffic roadblocks

62. As described above, Dr. Ricchetti purports to find that more MCSD traffic roadblocks are placed in areas with a high African-American resident population percentage than in areas where there is a low African-American resident population percentage. Dr. Ricchetti presents two different statistical comparisons of the traffic roadblocks in areas with a low and high African-American population percentage. In his first analysis, Dr. Ricchetti defines a low African-American resident population percentage as one where 28.0% or less of the population living in the census tract is African-American while a high African-American resident population percentage is one where 46.2% or more is African-American.

63. In his first statistical comparison Dr. Ricchetti compares the average number of roadblocks per 1,000 residents in low and high African-American population percentage areas over the 2012-2017 time period. He reports that areas with a high percentage of African-Americans have on average 28 roadblocks per 1,000 residents and areas with a low percentage of African-Americans have on average 14 roadblocks per 1,000 residents. In his second tabulation, he compares the number of roadblocks per 100 DUI arrests in low and high African-American population census tracts. He purports to find that the average number of roadblocks per 100 DUI arrests is higher in

census tracts with a high African-American population percentage than a low African-American population percentage.

64. Neither of Dr. Ricchetti's comparisons of the roadblocks in low and high African-American population percentage areas are statistically significant. That is, the purported difference between the average number of traffic roadblocks is not inconsistent with an outcome that could have been generated by sheer chance in a racially unbiased and neutral traffic roadblock location process. Incredibly, in contrast to generally accepted practices, Dr. Ricchetti does not present, and does not even appear to perform, tests of the statistical significance of his numerical comparisons.²⁷ Offering numerical comparisons without providing statistical significance tests, as Dr. Ricchetti has done, does not provide a manner by which to determine if the numerical differences he reports are truly anomalous or alternatively if the outcome could have been the result of sheer randomness.

65. Specifically, as was discussed at length above, the methodology and data underlying Dr. Ricchetti's calculations are defective and nonsensical. However, even if Dr. Ricchetti's numerical comparisons were not flawed, they are not statistically significant. Generally, in these types of statistical analyses a difference between two averages, such as the average number of roadblocks in a census tract group, is viewed as statistically insignificant if the difference between the averages of two similarly situated groups is consistent with an outcome that could have been generated by sheer chance in a racially unbiased and neutral process. In this analysis, and as is accepted

²⁷ See for example, Newbold, Carlson and Thorne, 'Statistics for Business and Economics', Seventh Edition

in the social sciences, a difference between the two averages is viewed as statistically significant if there is a **low or small** chance probability that a random and unbiased traffic roadblock process could have naturally produced the roadblock placement outcomes within the presumably similarly situated census tracts.²⁸ A chance probability of 1% or less or 5% or less is generally viewed as low.

66. It is common in some litigation settings, such as cases involving racial discrimination, for statistical significance to be discussed in terms of 'standard deviations' from the expected outcome. A standard deviation is a special statistic that measures how far a given outcome is from the average outcome. Generally speaking, random chance will produce numerical outcomes that naturally fall within two (2) standard deviations of the average outcome. Numerical outcomes that fall outside of this range are viewed as statistically significant. While there is no universal consensus on this issue, a numerical deviation that is more than two (2) or three (3) standard deviations from the mean is viewed as statistically significant by most analysts in the

²⁸ The concept of a low chance probability being statistically significant can be seen with the classic example of watching a person flip a coin. Think of watching a person flip a quarter five (5) times. In this setting, if the quarter was not weighted in anyway, then the probability of the quarter turning up 'heads' or 'tails' on any given flip would be 0.50 (50% chance). Based on this fact, the person watching the coin flips would expect to see the coin come up heads either two or three times ($0.50 \text{ probability heads} \times 5 \text{ coin flips} = 2.5 \text{ heads}$). In fact, it can easily be shown that there is a 0.625 (63.5% chance) that the coin will turn up heads two or three times.

Even if the quarter turned up heads only one time out of five flips, most people would not think that there was anything wrong with the quarter, since it is still reasonably likely for this outcome (about 1 in 6 or 0.1562) to happen by random chance. The person watching the coin flipper would simply say that random luck most likely caused the deviations from the expected outcome of two or three heads. In other words, this deviation or difference from the expected outcome would be viewed as statistically insignificant by the observer.

However, if the person watching the coin flipper observed no heads in any of the five coin flips, this would cause the reasonable person to question the fairness of the quarter. The observer may view the outcome with suspicion because it is not reasonably likely that the outcome was generated by sheer random chance. There is a 0.0312 or 3.12% chance of a fair coin turning up no heads in five coin flips.

Given this small chance probability, the observer would say that it is unlikely that random chance would have caused the deviation from the expected outcome. In other words, this deviation or difference from the expected outcome could be viewed as statistically significant by the observer.

social sciences, and as I understand them in the Courts.²⁹ A three (3) standard deviation difference approximately means there is less than a 0.5% probability, or less than 1 in 200 chance, that randomness could have generated the deviation.³⁰

67. Dr. Ricchetti's numerical comparisons are in fact not statistically significant. For example, if Dr. Ricchetti would have calculated the statistical significance of his first finding that areas with a high percentage of African-Americans have on average 28 roadblocks and areas with a low percentage of African-Americans have on average of 14 roadblocks, he would have seen that this difference is in fact not inconsistent with a randomness and an unbiased roadblock traffic location process. Dr. Ricchetti's aggregated sample of 21 census tracts across six years, is insufficient and cannot provide statistically meaningful and reliable inferences in this case. Dr. Ricchetti's purported finding that the average number of roadblocks per 100 DUI arrests is higher in census tracts with a high African-American population percentage is also statistically insignificant.

68. Dr. Ricchetti's statistical regression analysis further shows that the race of Madison County residents is not a statistically significant factor in the determination of where MCSD places traffic roadblocks. Accounting for even a small number of the errors in Dr. Ricchetti's statistical model shows that the racial composition of the census tract in which the traffic roadblock is placed is not a statistically significant

²⁹ See for example *Castaneda v. Partida*, 430 U.S. 482, 496 n.17 (1977)

³⁰ Statistical significance can also be evaluated by using probabilities or what is referred to as a p-value. Broadly speaking, a p-value is the probability that an outcome occurred by random chance. Typically, a probability value of 5% or less is considered statistically significant. It is common in Court settings to utilize a more stringent standard such as requiring a probability value of 1% or less to be viewed as statistically significant.

factor. His models clearly indicate that DUI activity, and not the race of Madison County, is the determining MCSD traffic roadblock factor.

69. Specifically, in his second analysis, Dr. Ricchetti reports that the number of MCSD traffic roadblocks in a geographical area increases as the percentage of African-Americans living in that geographical area increases. In this analysis of the frequency of MCSD traffic roadblocks, Dr. Ricchetti uses a statistical technique, referred to as a regression, to statistically account for the effect demographic differences of the residents living in the different census tracts have on the determination of MCSD traffic roadblock locations. For instance, he includes statistical factors to account for the effect that median household income and average unemployment rate in the census tract have on the determination of MCSD traffic roadblocks in Madison County.

70. In his analysis, Dr. Ricchetti finds that a one point increase in the African-American population percentage in a given census tract is correlated with an increase of approximately 0.06 traffic roadblocks in the census tract in a year. As was discussed above, Dr. Ricchetti's fundamental methodology and underlying data are critically flawed. Dr. Ricchetti's theoretical statistical model, which relies on census tract data on the race of the residents in Madison County, does not account for the racial demographics of the motoring public is actually driving through MCSD actual traffic roadblocks. Dr. Ricchetti actually compounds the flaws in his analysis by accounting for irrelevant statistical factors, such as the average unemployment rate and household income in the census tract. Dr. Ricchetti provides no professional, academic or even case documents, to support his theory that demographic and income factors associated

with the race of the residents is a determining factor in MCSD decisions, or any police agency for that matter, on where to place traffic DUI roadblocks.

71. I am not aware of law enforcement research or studies that suggest these types of residential demographic factors are valid factors to include in a study of traffic roadblock placement. As would be expected, the inclusion of these irrelevant statistical factors into regression analysis are not determinative of the frequency of MCSD traffic roadblocks in Madison County. In fact, in Dr. Ricchetti's statistical models the statistical impact of these factors individually on the frequency of roadblocks within census tract is essentially zero. That is, Dr. Ricchetti's factors concerning an increase in the unemployment rate or the percentage of the population that is between the ages of 15 and 24, have no statistically significant effect in his analysis and does not result in an increase or decrease in the number of traffic roadblocks in Madison County. In short, the demographic factors that Dr. Ricchetti includes in his model are irrelevant and have no bearing on MCSD determination of where to place traffic roadblocks in Madison.

72. Dr. Ricchetti's model clearly does not account for even a small number of the factors that are relevant to MCSD decision on where to location traffic roadblocks. Dr. Ricchetti acknowledged in his deposition that there were many factors that he in fact did not consider in his analysis.

Q: Did you consider any other factors about where you might -- where law enforcement might -- that law enforcement might apply in determining where to locate roadblocks?

A: I think, yeah, the factors, as I described in my report, are based on what defendants said and then the factors that I include in my model are the factors I considered, and those factors had a very high explanatory power.

Q: Do those factors take in any context?

MR. YOUNGWOOD: Objection; form.

THE WITNESS: What do you mean?

BY MR. NOBILE: Q Like context in the road, commercial areas, residential areas, schools, work patterns, work locations?

A: Yeah, there was not data on those types of factors in the CAD data.

Q: All right. But your factors don't account for that?

A: I would say that, yes, my factors do not account for the individual context of every roadblock.

Q: Of like different parts of the county, right? You'll agree with me, you know, the county is a fairly large area, correct?

A: Yes.

Q: And that it's -- you know, the population isn't and the commercial activity isn't homogenized within it, correct?

A: That's my understanding.

Q: And that there are different hub areas, so to speak, central locations where there are commercial activities, restaurants, large employers?

A: Yeah. And so --

Q: Do you agree with me?

A: I agree that that -- yes.

Q: And same thing with like recreational activities, there's certain areas where there may or may not be recreational activities?

A: Yes.³¹

³¹ See April 6, 2018 Deposition of Bryan Ricchetti, Ph.D., Pg. 60 Ln. 2-25, Pg. 61 Ln. 1-18

73. Even if the many defects in Dr. Ricchetti's model were ignored, it is clear from his own regression analysis that the placement of traffic roadblocks is determined by DUI activity and not the race of the individuals living within a given census tract in Madison County. As discussed, and even acknowledged by Dr. Ricchetti, DUI activity is factor that determines where MCSD traffic roadblocks are placed in Madison County. As was described previously, Dr. Ricchetti's own statistical results show that the statistical effect of the DUI activity dwarfs that of any possible racial effect many times over. Further, none of the other statistical factors in his model, like the unemployment rate or the percentage of the population that is between the ages of 15 and 24, matter whatsoever in his statistical regression model.

74. Dr. Ricchetti's results are particularly troubling in light of the fact that there are many factors that he does not account for in his statistical model. If his model were taken on face value as correct, his statistical model explains at most only 64.6% of 'how MCSD traffic roadblocks located in Madison County'. This means that there are at least 35.4% of 'how MCSD locates traffic roadblocks in Madison County' that is not explained by Dr. Ricchetti's model.³² Accounting for any number of these factors can

³² Moreover, Dr. Ricchetti has likely misspecified his regression model. In a regression model the independent variables, such as the number of DUIs, generally occur before the dependent variable, the number of roadblocks in this case is determined. Dr. Ricchetti's model confounds this issue. In his regression model, the dependent variable is the number of roadblocks per 1,000 people. The independent variable is the number of DUI arrests per 1,000 people in the same year as the roadblocks are counted. The independent and dependent variables may be viewed in terms of cause and effect in Dr. Ricchetti's model. If the independent variable is changed, then an effect is seen in the dependent variable. The problem with his specification is that he does not take into account that the number of roadblocks and the contemporaneous number of DUI arrests in the area are interlinked. The number of DUI arrests in the area determines the number of roadblocks in the future, but then the number of roadblocks also affects the number of DUI arrests. Research shows that roadblocks can reduce drunk driving. Individuals reported that a greater perceived chance of being pulled over for DUI corresponded to less alcohol-impaired driving on their part. Initially high number of DUI arrests in the area can lead to more roadblocks, which lowers drunk driving in the area and potentially leads to the lower number of DUI arrests and fewer roadblocks. In the regression model the independent variables generally occur before the dependent variable for the results to be valid. In this case the number of DUI

cause his *de minimis* findings to completely disappear. Although there exists a large volume of generally accepted statistical tests for these types of issues, Dr. Ricchetti performs no statistical test to determine what effect the factors that he omits from his analysis have on his findings.

75. In fact, accounting for even a small number of the factors that he omits from his model, shows that the race of the residents in Madison County is not a statistically significant factor in the determination of MCSD traffic roadblocks. For instance, simply accounting for bar and boat areas in his analysis shows that there is no statistically significant difference between the number of traffic roadblocks in low and high African-American population areas in any year. Similar to the results that Dr. Ricchetti reports, DUI activity continues to be the determining factor in the location of MCSD traffic roadblocks when these factors are accounted for in his statistical model.

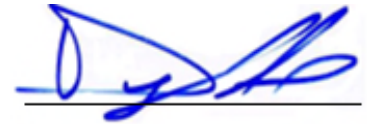
Conclusions

76. In sum, it is my opinion that Dr. Bryan Ricchetti's analysis is severely flawed and scientifically unreliable. Dr. Ricchetti's computer coding of the geographical location of MCSD traffic roadblocks is inaccurate throughout a substantial portion, and possibly throughout all, of the data he uses to perform his statistical analysis. The problems with Dr. Ricchetti's faulty data are compounded by the unsound methodology and the census data that he employs throughout his analysis. The methodology that Dr.

arrests that occurred prior to roadblocks, such as the number of DUI in previous year or in previous quarter, should be used as a dependent variable.

Frank A. Sloan, Sabrina A. McCutchan, Lindsey M. Eldred. Alcohol-Impaired Driving and Perceived Risks of Legal Consequences. *Alcoholism: Clinical and Experimental Research*, 2017; DOI: 10.1111/acer.13298

Ricchetti is attempting to use in his study of MCSD traffic roadblocks has been effectively debunked for a period of time. Dr. Ricchetti's research, even taken at face value (which should not be done, due to unreliability) clearly indicates that DUI activity and not race, is the key factor in MCSD traffic roadblock location placement. A closer examination of Dr. Ricchetti's tabulations and statistical analysis shows that there is in fact no statistically significant difference between the number of traffic roadblocks in low and high African-American population areas.



Dwight D. Steward

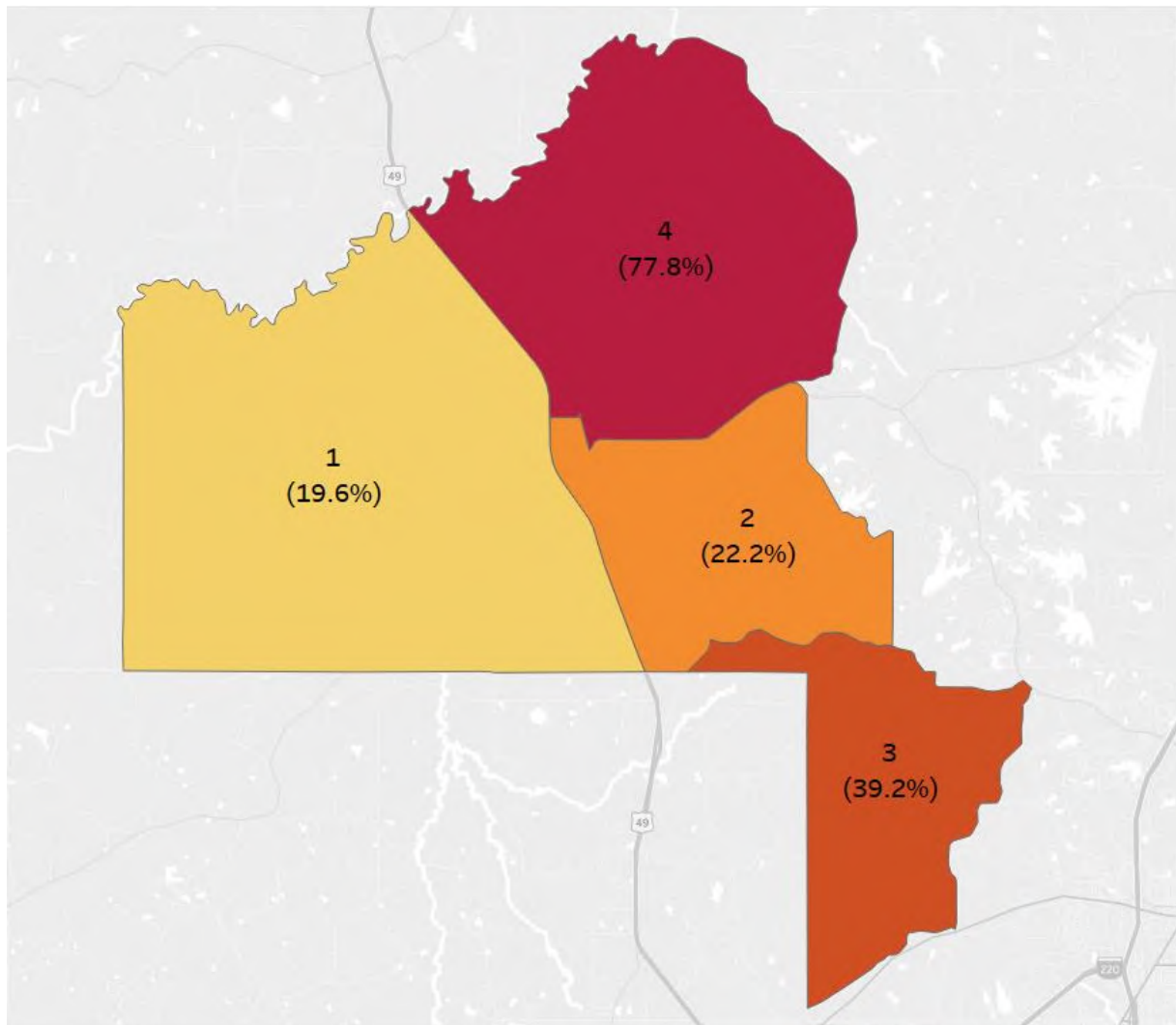
Tables and Figures

Table 1: Madison County Population 2012-2017

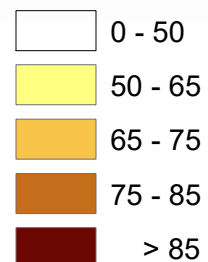
Census Tracts	Average African-American Population Percentage	# of Roadblocks 2012-2017	% of Total County Population	Average Annual Population
28089030101	10.7%	29	7.4%	7310
28089030202	10.9%	7	4.8%	4800
28089030203	11.6%	8	3.1%	3031
28089030301	11.6%	32	5.5%	5488
28089030206	13.0%	169	1.9%	1882
28089030204	14.7%	32	4.1%	4026
28089030104	16.5%	15	2.8%	2794
28089030205	17.9%	13	2.5%	2462
28089030107	18.0%	163	2.7%	2675
28089030201	18.6%	75	8.2%	8125
28089030400	28.0%	261	14.4%	14330
Average of Census Tracts with Low African-American Population Percentage	17.6%	804	57.4%	56922
28089030105	46.2%	10	3.3%	3309
28089030106	47.6%	132	5.0%	4953
28089030302	49.3%	158	6.7%	6665
28089030700	58.4%	13	1.0%	993
28089030800	59.6%	21	2.2%	2148
28089030108	65.6%	36	5.3%	5287
28089030900	69.5%	264	6.2%	6121
28089030600	83.7%	275	3.6%	3532
28089031000	84.0%	63	2.0%	1935
28089030500	89.5%	228	7.4%	7309
Average of Census Tracts with High African-American Population Percentage	66.0%	1200	42.6%	42251

Source: Dr. Ricchetti, Ph.D. Production Data

Figure 1: The African-American Population is Varied in Dr. Ricchetti's Census Tracts



Percentage African American



 Madison County 2017 Census Tracts

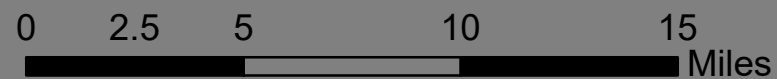
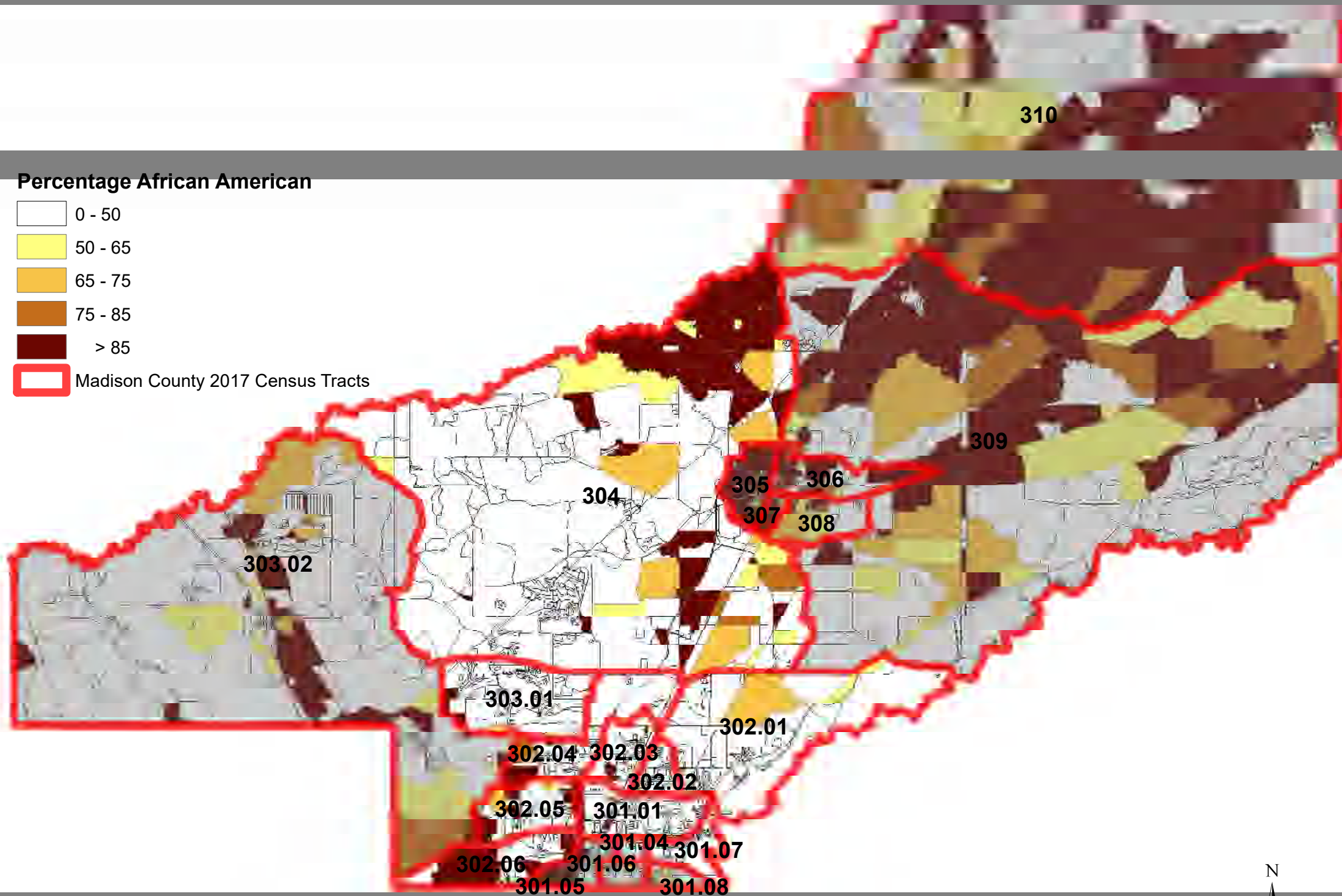
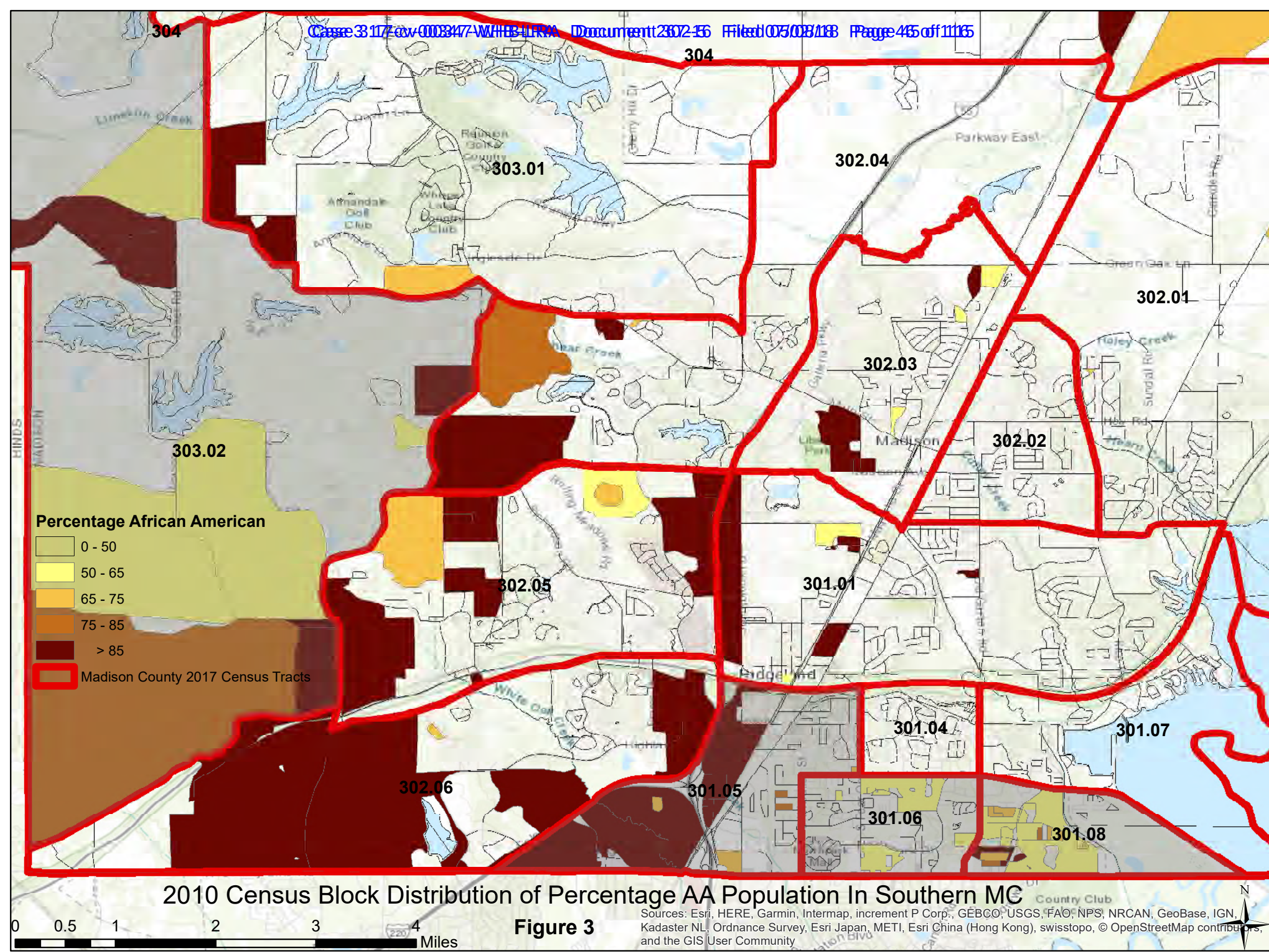
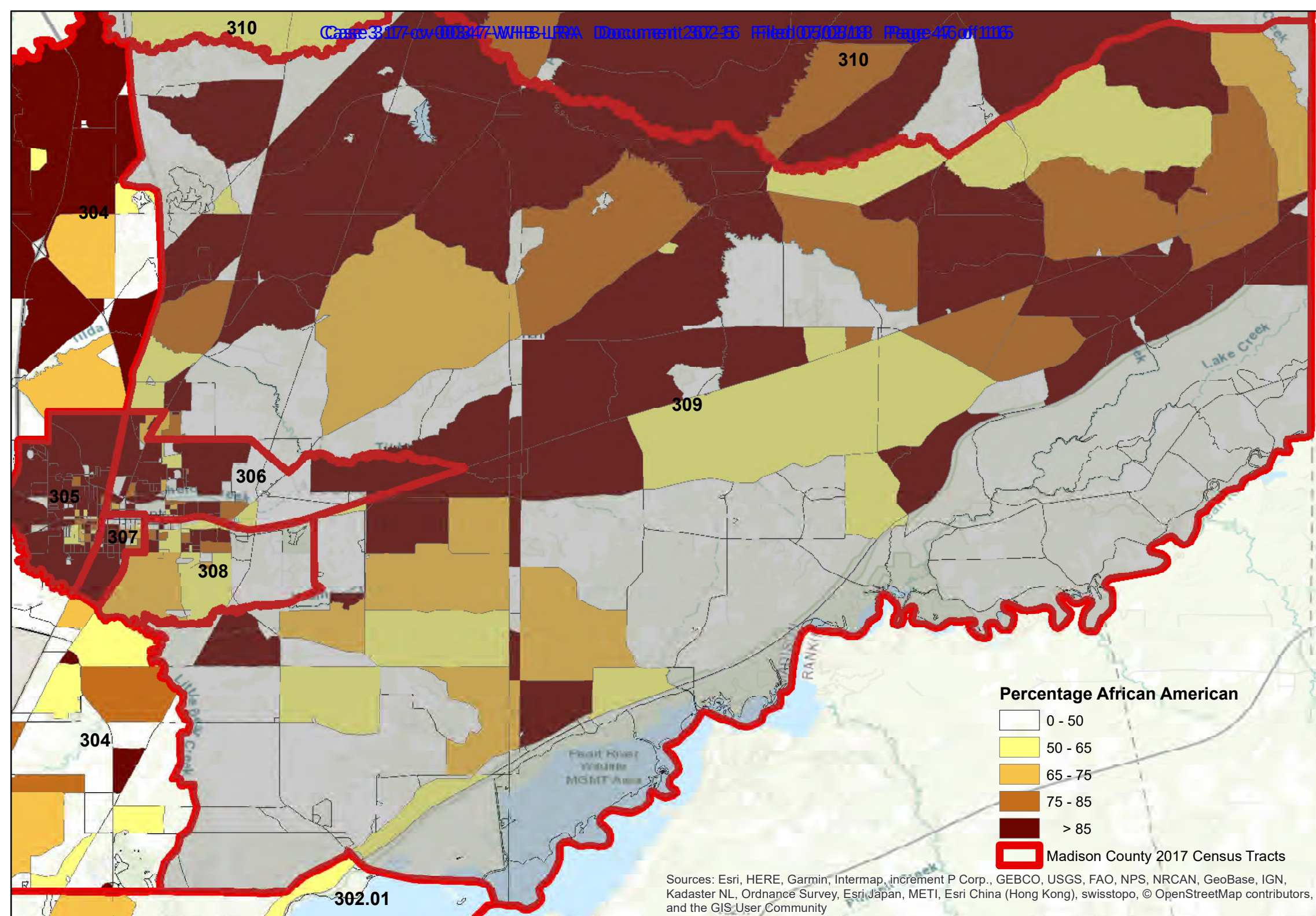


Figure 2







2010 Census Block Distribution of Percentage African American Population In Tract 309

Figure 4

0 0.75 1.5 3 4.5 6 Miles



Exhibit A: Curriculum Vitae



Economic & Statistical Research
Employment | Wage & Hour | Damages



Dwight Steward, Ph.D.
Economist and Statistician

Dr. Dwight Steward is an expert in the economic and statistical analysis of labor and employment related issues. He has experience in cases involving employment discrimination, wage and hour, lost earnings, and lost profits litigation.

As an expert witness, he has authored hundreds of reports, been deposed in over 200 cases and testified in over 60 trials. He has also testified in hearings, arbitrations, city council meetings, and before the Texas State legislature.

Dr. Steward writes regularly on employment related issues and frequently speaks to economic and legal professional groups. Dr. Steward's research on the statistical analysis of police racial profiling has received national attention. Dr. Steward has also taught in the University of Texas in the Department of Economics and the Red McCombs School of Business and in the College of Business at Sam Houston State University. He has taught numerous courses in statistics, labor economics, corporate finance, business policies, and the economics of the firm (microeconomics).

EDUCATION

Ph.D., Economics, University of Iowa; Dissertation title: 'Bank Mergers and Managerial Efficiency'

B.A., Economics, University of Texas at Austin; earned U.S. Army Officer Commission – Field Artillery

SELECTED ACTIVITIES

Visiting Scholar, University of Texas at Austin, Department of Economics, 2011-2012

President, University of Texas Army ROTC Alumni Association (Caissons), 2007-2009

Fellow, Texas Labor and Employee Relations Consortium, 2011 to present

Member, American Economic Association, Society for Human Resource Management, and National Association of Forensic Economists

Member, Beta Gamma Sigma Business Honor Society

Dissertation Scholar Fellow, Federal Reserve Bank of Atlanta, 1995

Field Artillery Officer, U.S. Army Reserve, 1990-1998, Honorably discharged; rank of First Lieutenant

EMPLOYMENT

Principal, EmployStats, 2008-present

Senior Lecturer, University of Texas at Austin, Department of Economics, 2010-2013, 1997-2003

Practice Director, Econ One, 2005-2008

Principal, Steward Research Group, 1997-2005

Senior Lecturer, University of Texas at Austin, Department of Economics, 1997-2003

Visiting Assistant Professor, College of Business, Sam Houston University, 1997-1999

Economist, Welch Consulting, 1995-1997

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Expert Witness Testimony Listing

Dwight Steward, Ph.D.

Balapuwaduge Mendis, on his own behalf and on behalf of all others similarly situated v. Schneider National Carriers, Inc., a Nevada Corporation, United States District Court Western District of Washington, deposition testimony February 2018.

Richard Patton v. Houston Independent School District, In the District Court of Harris County, Texas 295th Judicial District, deposition testimony January 2018.

Mandy Thompson and Kevin Torrez, individually and as next friends and representatives of Ayden Torrez, a minor v. St. David's Healthcare Partnership, L.P., LLP, d/b/a St. David's Medical Center; Jeff E. Hagen, M.D.; Jeff E. Hagen, M.D., P.A., d/b/a Austin OBGYN; and Maria E. Gutierrez, RNC, NP, MSN, In the District Court Travis County, Texas 353rd Judicial District, deposition testimony January 2018.

Jose Luis Alcantar, on behalf of himself and all others similarly situated v. Hobart Service, Hobart Food Equipment Group, Itw Food Equipment Group, LLC, and Does 1 through 100, inclusive, United States District Court, Central District of California, deposition testimony December 2017.

Karen Cunningham, Individually, as Heir at Law, and as Representative of the Estate of Steven Cunningham, Deceased; Sami Staley; Beatrice Cunningham; Jonathan Vigil; Andrew Tkaczyk; Zachary Johnson; James Riley; Timothy Irons; Charles Billings; Nathan Wilden; Christopher Davis; and Armando Cardona; and Daniel Luppino v. Nikki Hoke, as Representative of the Estate of Gregory M. Hoke, Deceased; Bordur Studios Coach Leasing LLC; and Big Sexy Grey Bus LLC; and Nikki Hoke, Individually, as Representative of the Estate of Gregory M. Hoke, Deceased, and as Next Friend of E.H. and H.H., minor children of Gregory M. Hoke, Deborah Hoke, Individually, and Russel Hoke, Individually v. Bridgestone Americas Tire Operations, LLC, a foreign Company which is the successor to Bridgestone/Firestone North American Tire, LLC, In the District Court of Hudspeth County, Texas 394th Judicial District, deposition testimony November 2017.

Jose F. Andino, individually and on behalf of himself and others similarly situated v. Kaiser Foundation Hospitals, a California Corporation, and Does 1 through 100, inclusive, Superior Court of the State of California For the County of Alameda, deposition testimony October 2017.

Jeffrey Fadness v. Charter Communications, Inc., In the District Court Travis County, Texas 261st Judicial District, deposition testimony October 2017.

Paris Shoots, Jonathan bell, Maxwell Turner, Tammy hope, Phillipp Ostrovsky, Brenda Brandt, Anissa Sanders, Najai McCutcheon, and Leticia Rodriquez, on behalf of themselves, the Proposed Rule 23 Classes and others similarly situated, v. IQOR Holdings, Inc., United States District Court District of Minnesota, deposition testimony August 2017.

Timothy K. Sargis and Dawn M. Sargis, Individually and as Next Friends of Madisyn Marie Loher, A Minor and as Personal representatives of the Estate of Michelle Loher, and Gary S. Loher, II v. HS Centex Trucking, LLC, Kevin Clay and USAA General Indemnity Company, In the District Court Coryell County, Texas 52nd Judicial District March 2017.

Stacey Burkhart and Brandon Burkhart Individually and As Parents and Next Friends of Austin Burkhart, a Minor v. United Regional Health Care System, Inc. d/b/a United Regional Hospital, United Regional Hospital, Texoma Women's Clinic, P.A. d/b/a The Women's Center, and Lawrence Y.H. Young, M.D., In the District Court 78th Judicial District Wichita County, Texas November 2016

Troy Slack, Jacob Grismer, Richard Erickson, Scott Praye, Gary H. Roberts, Robert P. Ullrich, Henry Ledesma, Timothy Helmick, Dennis Stuber, Eric Dublinkski, Sean P. Forney v. Swift Transportation Co., of Arizona, LLC., United States District Court Western District of Washington at Tacoma, deposition testimony November 2016

Richard Trusz v. UBS Realty Investors LLC and UBS AG, United States District Court District of Connecticut, deposition testimony September 2016

Amy L. Schneider and Janet E. Breneman, individually and on behalf of others similarly situated, v. Union Hospital, Inc., United States District Court Southern District of Indiana Terre Haute Division, deposition testimony June 2016

Corey Khansari, Debra Khansari and Michael Khansari v. The City of Houston, Chief of Police Charles A. McClelland, Jr., Officer William E. Rutherford, Officer Candace M. Bradshaw Vaughn, Officer Jillian McGowan, Officer Maria Hernandez, Officer Sean Hunter, Officer Jorge Luis Herrera, and Officer Walter Gaw, United States District Court Southern District of Texas Houston Division, trial testimony April 2016

Donald and Mary Trichel, individually and as Next Friends of Nicholas Trichel v. Union Pacific Railroad Company and Jeremy Ray Hampton, In the District Court of Harris County, Texas 125th Judicial District, deposition testimony April 2016

Virginia Nester and Robert Scott Nester, Individually and As Next Friends of C.N. and S.N., Minors v. Textron, Inc. d/b/a E-Z-GO United Rentals, Inc. f/k/a RSC Holdings, Inc. and/or RSC Equipment Rental, In the United States District Court for the Western District of Texas Austin Division, trial testimony March 2016

Chris Elliott O/B/O Himself and O/B/O All Other Similarly Situated, v. Schlumberger Technology Corporation and Schlumberger Limited (Schlumberger N.V.), United States District Court for the District of North Dakota Southeastern Division, deposition testimony March 2016

United States of America, ex rel. Louis Scutellaro v. Capitol Supply, Inc., United States District Court District of Columbia, deposition testimony February 2016

Monica Hague v. University of Texas Health Science Center at San Antonio, In the United States District Court for the Western District of Texas San Antonio Division, trial testimony January 2016

Arleen Delaronde v. Legend Classic Homes, Ltd., Bella Vista C.M.I., Ltd., In the United States District Court for the Southern District of Texas Houston Division, trial testimony December 2015

Genoveva Guzman and Abel Ochoa, Individually and as Parents and Next Friend of Maria Guadalupe Ochoa v. Tenet Healthcare Corporation, Hughan Frederick, M.D., Isis Obstetrics & Gynecology, LLC, A. Ellery, RN, North Fulton Hospitalist Group, LLC D/B/A North Fulton Regional Hospital A/K/A Tenet North Fulton Hospital, and John Does 1-10, In the State Court of Fulton County, State of Georgia, deposition testimony September 2015

Jose Arellano and Juan Montoya, individually, and on behalf of all others similarly situated v. Container Connection of Southern California, Inc., a California Corporation; and Does 1 through 100, Superior Court of the State of California for the County of Los Angeles, deposition testimony September 2015

Monica Hague v. University of Texas Health Science Center at San Antonio, In the United States District Court for the Western District of Texas San Antonio Division, deposition testimony August 2015

Jesus Holguin, Individually and o/b/o The Estate of Maria E. Holguin, Deceased, Estevan A. Gonzales, Jesus Ramon Holguin and Kassandra M. Holguin, Minor Children v. Baptist St. Anthony Health System, In the District Court of Potter County, Texas, deposition testimony July 2015

Mark Virant v. Encana Oil & Gas (USA), Inc. and Eric Marsh, Individually, In the District Court of Tarrant County, Texas 153 Judicial District, deposition testimony July 2015

Fred Devries, Ruby Teich, Janine Natoli, Rafael Santiago, Mark Malter, Adam Schwartz, individually and on behalf all others similarly situated v. Morgan Stanley & Co. LLC, f/k/a Morgan Stanley & Co. Incorporated, Morgan Stanley Smith Barney LLC, and Morgan Stanley, In the United States District Court for the Southern District of Florida, deposition testimony July 2015

Virginia Nester and Robert Scott Nester, Individually and As Next Friends of C.N. and S.N., Minors v. Textron, Inc. d/b/a E-Z-Go, United Rentals, Inc. f/k/a RSC Holdings, Inc. and/or RSC Holdings, Inc. and/or RSC Equipment Rental, In the United States District Court for the western District of Texas Austin Division, deposition testimony June 2015

Lisa Rindfleisch, Tiffany Melendez, Michelle Gentile, Laurie Baker and Christina Nelmes, on behalf of themselves and other similarly situated, v. Gentiva Health Services, Inc., In the United States District Court for the Eastern District of New York, deposition testimony June 2015

Karen Oubre, Individually and o/b/o The Estate of Larry Oubre, Deceased v. Kyle Mezger, M.D.; Christopher Thu, M.D.; and Capitol Anesthesiology Association, In the District Court of Travis County, Texas 126th Judicial District, Texas deposition testimony May 2015

Weird Times, LLC v. Sharon Ma and Doug Ma, In the District Court 353rd Judicial District Travis County, Texas, trial testimony March 2015

Armida Rodriguez and Chea Hill, individually, and on behalf of all other similarly situated and on behalf of the general public, vs. Burlington Coat Factory Warehouse Corporation, a New Jersey Corporation; Burlington Coat Factory of California LLC, a California Limited Liability Company; and Does 1 through 50, inclusive, United States District Court - Central District of California, deposition testimony February 2015

Guang Tian, Yan Nie, Jing Jian Wu, Zhen Sheng Yin, Tie Quan Ma, as individuals, and Ming Fang Tie, Yu Hong Chang, Yi Wu, Bao Jie Zhang, Chao Hui Liu, on Behalf of Themselves and all others similarly situated, and Christopher Cavaliere and Steven Lee, on behalf of themselves and as PAGA representatives v. Ma Laboratories, Inc., Abraham C. Ma, also known as Chih Keng Ma, and Christine Rao, also known as Ruiting C. Rao, Superior Court of the State of California County of Santa Clara Unlimited Jurisdiction, deposition testimony January 2015

Uzoamaka Enezuagu; Yoseph Awlachew; Kiflom Birhane; Desalgne Zema; Simon Gebrekiros; Jacqueline Jackson; Abebech Kassie; Abdou Ouedraogo; Raquel Pryce-King; Ephrem Tessema; Yonas Woldemicael; Shamara Wright; Helen Zegeye; Alemayehu Zeleke; Jekeia Sledge; Ann-Marie Glanville; Alex Garrett; Sara Kebeta; Getnet Retta; Emmanuel Vincent; Tatek Zema v. Board of Trustees of the University and Does 1 through 10 inclusive, Superior Court of the District of Columbia Civil Division, deposition testimony November 2014

Sergio Gutierrez, an individual; Hector Salazar, an individual, both individually on behalf of themselves and on behalf of all other similarly situated current and former employees of Defendant Commerce Casino v. California Commerce Club, Inc. doing business as Commerce Casino, and Does 1 through 50, inclusive, Superior Court of the State of California for the County of Los Angeles, deposition testimony November 2014

Yvette Anderson, et al., v. County of Ventura; and Does 1-10, inclusive, United States District Court, Central District of California, deposition testimony July 2014

Jesus Castro Romo v. The United States of America, United States District Court, District of Arizona, trial testimony July 2014

Ngan Huynh and Tuan M. Nguyen Individually and As Parents, Legal Guardians and Next Friends of Jonathan Nguyen, A Minor v. St. David's Healthcare Partnership, L.P.; LLP Individually and d/b/a St. David's North Austin Medical Center a/k/a North Austin Medical Center; Round Rock Hospital, Inc.; St. David's Foundation p/k/a St. David's Health Care System, Inc.; Renaissance Women's Group, P.A.; Tara A. Mills, M.D.; Devin M. Garza, M.D.; Kristen Barkow a/k/a Kristen Calnan, NP, In the District Court Travis County, Texas, 200th Judicial District, deposition testimony July 2014

Veronica Ochoa Valenzuela and Cesar De Viana, husband and wife v. Ford Motor Company, a Foreign Corporation, In the United States District Court for the District of Arizona, trial testimony May 2014

Johnson, et al v. York Claims Service, Inc., Superior Court of the State of California in and for the County of Sacramento, trial testimony May 2014

Michael Mercieca v. Tracey Rummel, and Microsoft Corporation, In the District Court 353rd Judicial District Travis County, Texas, trial testimony May 2014

Johnson, et al v. York Claims Service, Inc., Superior Court of the State of California in and for the County of Sacramento, deposition testimony April 2014

Yadira Hernandez v. R.E.S.A., Inc., d/b/a Keller Williams Realty and Carolina Salcedo Cuevas, In the District Court 131st Judicial District, Bexar County, Texas, trial testimony April 2014

Charles E. Amos, II v. Plan Administrator of Orion Healthcorp, Inc., Employee Benefit Plans, Orion Healthcorp, Inc., Employee Benefit Plans, Orion Healthcorp, Inc., RMI Physician Services Corporation, Chi T. “Cindy” Luu, Kimberly Singleton, RMI Physician Services Corporation Employee Benefit Plans, Plan Administrator of RMI Physician Services Corporation Employee Benefit Plans, In the United States District Court for the Southern District of Texas Houston Division, deposition testimony April 2014

Gerald Bramlett, v. Dimensional Investment LLC before the American Arbitration Association, Austin, Texas, arbitration testimony February 2014

Gerald Bramlett, v. Dimensional Investment LLC before the American Arbitration Association, Austin, Texas, deposition testimony December 2013

Renee M. Hawkins, Individually and on behalf of others similarly situation v. Alorica, Incorporated, United States District Court for the Southern District of Indiana Terre Haute Division, deposition testimony December 2013

Jodi Soukup, Individually, and as Parent, Legal Guardian and Next Friend of Ryan Burford, A Minor v. Methodist Healthcare Ministries of South Texas, Inc. d/b/a Southwest Texas Methodist Hospital, and/or d/b/a or a/k/a/ Methodist Hospital; Columbia/HCA Healthcare Corporation of Central Texas; Methodist Healthcare Ministries of South Texas Inc.; Patricia K. Brougher, M.D. and Patricia K. Brougher, M.D., P.A., In the District Court 45th Judicial District Bexar County, Texas, deposition testimony December 2013

Ben Deason v. Jennifer Newsom, in the 145th District Court in and for the County of Nacogdoches County, Texas, deposition testimony October 2013

Tracy Windrum, Individually, as representative of the Estate of Lancer Windrum, and on behalf of her minor children Bethany Windrum, Jacob Windrum, and Holly Windrum v. Victor Kareh, M.D., Harpaul Gill, M.D., North Cypress Medical Center, North Cypress Medical Center Operating Company, GP, LLC, North Cypress Medical Center Operating Company, LTD and Coresource, Inc., In the District Court of Harris County, Texas, 133rd Judicial District, trial testimony October 2013

Victoria “Anna” Janssen v. O’Reilly Automotive Stores, Inc., In the United States District Court for the Northern District of Texas Wichita Falls Division, Wichita Falls, Texas, trial testimony September 2013

Denise K. Aguilar v. St. David’s Healthcare Partnership, LP, LLC d/b/a South Austin Medical Center, American Arbitration Association, Austin, Texas, deposition testimony August 2013

Deann Hojnacki v. Trisun Healthcare, LLC, Arbitration Austin, Texas, deposition testimony August 2013

Yadira Hernandez v. R.E.S.A., Inc., D/B/A Keller Williams Realty and Carolina Salcedo Cuevas, In the District Court 131st Judicial District, Bexar County, Texas, deposition testimony May 2013

Y. Hoang Do, M.D. v. Texas Health and Human Services Commission, Office of Inspector General, Before the Health and Human Services Commission Appeals Division, Travis County, Texas, trial testimony May 2013

David Meyer, Individually and o/b/o The Estate of Doreen Rae Meyer, Deceased, Sunny Ruud, Brandy Cebula, and Jon Novitsky o/b/o Krystin Novitsky, Minor Child v. Stephen Bodi, P.A. and M.D.'s Cyber Clinic, P.A. D/B/A Northwest Diagnostic Clinic, In the District Court of Williamson County, Texas 368th Judicial District, deposition testimony March 2013

Instant Technology, LLC, an Illinois Limited Liability Company, v. Elizabeth Defazio, Laura Rehn, Megan Marker, Bethany Meek, Erin Bauer, Joel Katz, Andrea Katz, individuals and Connect Search, LLC, a Delaware Limited Liability Company, In the United States District Court for the Northern District of Illinois, Eastern Division, deposition testimony January 2013

United Biologics, LLC, D/B/A United Allergy Labs & Nicolas Hollis v. Texas Allergy, Asthma and Immunology Society; Stuart L. Abramson, MD, PHD; Wesley W. Stafford, MD; Theodore M. Freeman, MD; William R. McKenna, MD and Michael P. Vaughn, MD, PHD, In the District Court of Travis County, Texas 353rd Judicial District, deposition testimony January 2013

Lisa Rindfleisch, Tiffany Melendez, Michelle Gentile, Laurie Baker and Christina Nelmes, on behalf of themselves and others similarly situated, v. Gentiva Health Services, Inc., In the United States District Court Northern District of Georgia Atlanta Division, deposition testimony January 2013

Jose Luis Alcantar, on behalf of himself and all others similarly situated v. Hobart Service, et al., United States District Court for the Western District of Texas, deposition testimony January 2013

Certain Underwriters at Lloyd's London and Professional Liability Insurance Services, Inc. v. IMA of Kansas, Inc., In the District Court of Travis County, Texas 353rd Judicial District, trial testimony November 2012

Equal Employment Opportunity Commission v. Valero Refining – Texas LP, In the United State District Court for the Southern District of Texas Galveston Division, deposition testimony October 2012

United Biologics, LLC, Formerly d/b/a United Allergy Services, Formerly d/b/a United Allergy Labs & Nicolas Hollis v. Texas Allergy, Asthma and Immunology Society; Stuart L. Abramson, MD, PHD; Wesley W. Stafford, MD; Theodore M. Freeman, MD; William R. McKenna, MD, and Michael P. Vaughn, MD, PHD., In the District Court of Travis County, Texas 353rd Judicial District, deposition testimony October 2012

Y. Hoang Do, M.D. v. Texas Health and Human Services Commission, Office of Inspector General, before the Health and Human Services Commission Appeals Division, Texas, deposition testimony October 2012

Xochitl Segovia, v. Williams Brothers Construction Company, Inc., In the District Court of Harris County, Texas 333 Judicial District, trial testimony August 2012

ADP, Inc., a Delaware Corporation v. National Merchant Alliance, LLC, a Nevada Limited Liability Company, United States District Court for the Western District of Texas, deposition testimony June 2012

Dustin R. Thompson, v. J4 Development, LP, In the District Court of Travis County, Texas 200th Judicial District, deposition testimony June 2012

Certain Underwriters at Lloyd's London and Professional Liability Insurance Services, Inc. v. IMA of Kansas, Inc., In the District Court of Travis County, Texas 353rd Judicial District, deposition testimony May 2012

James R. Irion, III and Veniece M. Irion v. Sunrise Senior Living Management, Inc., D/B/A Brighton Gardens of Austin; and Prime Care Seven, LLC D/B/A Brighton Gardens of Austin, United States District Court Western District of Texas Austin Division, deposition testimony May 2012

Elsa Ortega on behalf of S.L.O. and J.L.O. minors, et al v. United States of America, Jose Vicente Gaytan-Alcaya, et al, v. United States of America; Elsa Ortega and John Doe Ortega, Husband and Wife, In the United States District Court for the District of Arizona, deposition testimony April 2012

William Kierre v. Gerry Lawler, M.D. and Hendrick Anesthesia Network, In the District Court of Taylor County 104th Judicial District, trial testimony April 2012

Dawn Leamon, v. KBR, Inc.; et al, In the United States District Court for the Southern District of Texas Houston Division deposition, testimony April 2012

Wilson Industries, L.P., v. Select Energy Services, LLC; and Bell Supply, LLC; In the District Court of Ector County, Texas 244th Judicial District, deposition testimony March 2012

Debra Nicholas v. San Antonio Water System, In the District Court 57th Judicial District Bexar County, Texas, trial testimony March 2012

Lielonnie R. Lewis v. Save Mart Supermarkets and Does One through Fifty, inclusive, Superior Court of the State of California in and for the County of Alameda, deposition testimony February 2012

Flordeliza Escano, Marila P. Maximo, Joel T. Catublas, and Penny Burney, on behalf of themselves and behalf of all other similarly situated, v. Kindred Healthcare Operating, Inc., a Delaware Corporation, Kindred Healthcare, Inc., a Delaware Corporation, Specialty Hospitals of Southern California, a business form unknown, and Does 1 through 100, United States District Court Central District of California (Western Division – Los Angeles), deposition testimony February 2012

Anthony Stout, on behalf of himself and others similarly situated, v. Universal Ensco, Inc., United States District Court Southern District of Texas Houston Division, deposition testimony November 2011

Lashone Purnell, as an individual and on behalf of all employees similarly situated, v. Sunrise Senior Living Management, Inc., and Does 1 through 50, inclusive, United States District Court Central District of California Southern Division, deposition testimony August 2011

Jamie Leigh Jones v. Halliburton Company d/b/a KBR Kellogg Brown & Root (KBR); Kellogg Brown & Root Services, Inc.; Kellogg Brown & Root International Inc.; Kellogg Brown & Root, LLC; Kellogg Brown & Root, Inc.; Kellogg Brown & Root Inc.; Kellogg Brown & Root, S. de R.L.; Kellogg Brown & Root (KBR), Inc.; KBR Technical Services, Inc.; Overseas Administrative Services, Ltd.; Eric Iler, Charles Boartz; Several John Doe Rapists and the United States of America, In the United States District Court for the Southern District of Texas (Houston Division), trial testimony June 2011

Debbie Goodwill, Individually and on Behalf of the Estate of Larry Goodwill, Cody Goodwill, and Wendy Christian v. United Parcel Service, Inc., et al, In the U.S. District Court for The Western District of Texas Austin Division, trial testimony June 2011

Veronica Ochoa Valenzuela and Cesar De Viana, husband and wife v. Ford Motor Company, a Foreign Corporation, In the United States District Court for the District of Arizona, deposition testimony May 2011

Jamie Leigh Jones v. Halliburton Company d/b/a KBR Kellogg Brown & Root (KBR); Kellogg Brown & Root Services, Inc.; Kellogg Brown & Root International Inc.; Kellogg Brown & Root, LLC; Kellogg Brown & Root, Inc.; Kellogg Brown & Root Inc.; Kellogg Brown & Root, S. de R.L.; Kellogg Brown & Root (KBR), Inc.; KBR Technical Services, Inc.; Overseas Administrative Services, Ltd.; Eric Iler, Charles Boartz; Several John Doe Rapists and the United States of America, In the United States District Court for the Southern District of Texas (Houston Division), deposition testimony May 2011

Michael L. Collier, Ph.D. v. Texas Tech University and John Whitmore in his Official Capacity, In the District Court 99th Judicial District Lubbock County, Texas, trial testimony May 2011

Debbie Goodwill, Individually and on Behalf of the Estate of Larry Goodwill, Cody Goodwill, and Wendy Christian Plaintiffs, Cecelia Center, Individually and as Administrator of the Estate of George Reagan Center Intervenors, v. United Parcel Service, Inc., Tire Centers, LLC d/b/a TCI, and The Goodyear Tire & Rubber Company, In the United States District Court for the Western District of Texas Austin Division, deposition testimony March 2011

Albert Kevin Martin, A/K/A Kevin Martin v. City of San Antonio and Its Agent, San Antonio Water System, In the District Court 224th Judicial District, Bexar County, Texas, trial testimony February 2011

Delanie Ney, v. iProfile, LLC, Accord Human Resources, Inc. Virgo Capital Fund I, LP, Hemanth Parasuram, Guhan Swaminathan and Arun Prakash, Arbitration Cause No. 701600042810, Austin, Texas, arbitration testimony January 2011

State of Texas ex rel., Ven-A-Care of the Florida Keys, Inc. v. Alpharma USPD f/k/a Barrenational, Inc., Purepac Pharmaceutical Co., Actavis Mid Atlantic LLC, Actavis Elizabeth LLC, Barr Pharmaceuticals, Inc., Barr Laboratories, Inc., Duramed Pharmaceuticals, Inc., Pliva, Inc. f/k/a Sidmak Laboratories, Inc., Odyssey Pharmaceuticals, Inc., PAR Pharmaceutical, Inc., PAR Pharmaceutical Companies, Inc., Watson Pharmaceuticals, Inc., Watson Pharma, Inc. f/k/a Schein Pharmaceutical, Inc., Rugby Laboratories, Inc., Oclassen Pharmaceuticals, Inc., Marsam Pharmaceuticals, Inc., and Andrx Pharmaceuticals, Inc., In the District Court of Travis County, Texas, 419th Judicial District, trial testimony, January 2011

Kevin Blackwell and Amber Blackwell, Individually and As Next Friend of K.B. and S.B., Minors v. Nissan Motor CO., LTD. And Nissan North America, Inc., In the United States District Court for the Eastern District of Texas Beaumont Division, deposition testimony January 2011

Nicholas Tableriou, Individually, and as Administrator of the Estate of Jane Tableriou, Deceased, Nicole Tableriou, and Brett Tableriou v. John Marsden, M.D., Marsden One GP, LLC, Marsden One, LTD., Marsden Management, LLC, and The American Institute of Gastric Banding, LTD., D/B/A True Results, In the District Court Travis County, Texas 261st Judicial District, deposition testimony October 2010

Prudence Adams v. Centex Freight Lines, LLC, In the District Court Travis County, Texas Judicial District, trial testimony October 2010

Jeanette Eberhart; Hamilton Beaux O’Keady-Elicock; Howard Hill; and Philip Marc Orlow v. Frye Claims Consultation and Administration, Inc. a California Corporation, In the Superior Court of the State of California, Alameda County, deposition testimony September 2010

Shaunetta Eddings, individually and on behalf of a class of similarly situation individuals, v. Health Net, Inc., In the United States District Court for the Central District of California, deposition testimony September 2010

Equal Employment Opportunity Commission and Connie Beseda, v. Zachry Industrial, Inc. (San Antonio) F/K/A Zachry Construction Corporation, (San Antonio), In the United States District Court for the Western District of Texas San Antonio Division, deposition testimony September 2010

Candice Warde Rodriguez, Individually and on Behalf of Benjamin Wallace Rodriguez, a Minor, v. The United States of America, In the United States District Court, Eastern District of New York, deposition testimony August 2010

Ronica R. Tabor on behalf of herself and all others similarly situated, Dacia S. Gray on behalf of herself and all others similarly situated, v. Hilti, Inc. a Domestic For Profit Business Corporation, and Hilti of America, Inc., a Foreign For Profit Business Corporation, In the United States District Court for the Northern District of Oklahoma, deposition testimony August 2010

State of Texas ex rel., Ven-A-Care of the Florida Keys, Inc. v. Alharma USPD f/k/a Barrenational, Inc., Purepac Pharmaceutical Co., Actavis Mid Atlantic LLC, Actavis Elizabeth LLC, Barr Pharmaceuticals, Inc., Barr Laboratories, Inc., Duramed Pharmaceuticals, Inc., Pliva, Inc. f/k/a Sidmak Laboratories, Inc., Odyssey Pharmaceuticals, Inc., PAR Pharmaceutical, Inc., PAR Pharmaceutical Companies, Inc., Watson Pharmaceuticals, Inc., Watson Pharma, Inc. f/k/a Schein Pharmaceutical, Inc., Rugby Laboratories, Inc., Oclassen Pharmaceuticals, Inc., Marsam Pharmaceuticals, Inc., and Andrx Pharmaceuticals, Inc., In the District Court of Travis County, Texas, 419th Judicial District, deposition testimony July 2010

Randall Barnett v. City of Austin, et al.; 353rd Judicial District Court, Travis County, Texas, hearing testimony May 2010

Lugo, et al., v. Farmers Pride, In the United States District Court for the District of Pennsylvania, deposition testimony May 2010

William Kierre v. Gary Lawler, M.D. and Hendrick Anesthesia Network, In the District Court, Taylor County, Texas, 104th Judicial District, deposition testimony April 2010

Ann Otsuka, an individual and on behalf of all others similarly situated; Janis Keefe, an individual; Corinne Phipps, and individual; Justin Kiser, an individual; and Renee Davis v. Polo Ralph Lauren Corporation; Polo Retail, LLC; Polo Ralph Lauren Corporation, doing Business in California as Polo Retail Corporation; and Fashions Outlet of America, Inc., United States District Court Northern District of California, trial testimony March 2010

Wai Chan, On behalf of herself and all others similarly situated v. Wells Fargo Financial, Inc., In the United States District Court for the Western District of Missouri, deposition testimony February 2010

Billy Petty, Edward Petty and Amanda Stewart v. Devesh Ramnath, M.D., In the District Court Administratively transferred to the 95th Judicial District Dallas County, Texas, deposition testimony February 2010

Luna v. Weddington, In the District Court of Harris County, Texas Judicial District 234, trial testimony January 2010

Ann Otsuka, an individual and on behalf of all others similarly situated; Janis Keefe, an individual; Corinne Phipps, and individual; Justin Kiser, an individual; and Renee Davis v. Polo Ralph Lauren Corporation; Polo Retail, LLC; Polo Ralph Lauren Corporation, doing Business in California as Polo Retail Corporation; and Fashions Outlet of America, Inc., United States District Court Northern District of California, deposition testimony December 2009

Mark Scherer, Doug Paslay and Hazel Bailey, individually, and on behalf of all other similarly situated v. Duke Energy Fossil-Hydro California Inc., a Delaware Corporation, and Wood Group Power Operations, Inc. A Nevada Corporation and Does 1 to 50, in the Superior Court of the State of California, County of Los Angeles, deposition testimony December 2009

Michael K. McLennan, v. Applied Materials, Inc., United States District Court Western District of Texas Austin Division, deposition testimony December 2009

Wilfredo Cruz, Matthew Allbee, Guadalupe Varela, Raul Torres, and Ken Joseph, individually and on behalf of a class of similarly situation persons, v. Unilock Chicago, Inc., an Illinois Corporation, In the Circuit Court of the Sixteenth Judicial District Kane County, Illinois, deposition testimony December 2009

Daniel Friedenbach, Individually and on behalf of all survivors of the Estate of Lorie Frazier Friedenbach, v. Gary A. Croll, in the District Court of Dallas County, Texas, 14th Judicial District, deposition testimony November 2009

Fermin Cortez, et al., v. Nebraska Beef, Inc., and Nebraska Beef, LTD., David Chuol, et al., v. Nebraska Beef, LTD., The United States District Court For The District of Nebraska, deposition testimony November 2009

Jeff Gebenus and Wesley Chong, individuals, on behalf of themselves and others similarly situated v. Rite Aid Corporation, a Delaware corporation, and Thrifty Payless, Inc., a California Corporation, in the Superior Court Of Washington For King County, deposition testimony November 2009

Margaret A. Guerra v. San Antonio Water System; Pending in the 73rd Judicial District Court, Bexar County, Texas, deposition testimony September 2009

David and Esther Luna v. Lloyd Damon Weddington, M.D. and Diabetes Center of America, In The District Court Of Harris County, Texas, 234Th Judicial District, deposition testimony September 2009

Wilfredo Cruz, Matthew Albee, Guadalupe Varela And Raul Torres, Individually and on behalf of a class of similarly situated persons, v. Unilock Chicago, Inc., An Illinois Corporation, and Jonathon Harn, An Individual, In the Circuit Court Of Sixteenth Judicial District, Kane County, Illinois, deposition testimony September 2009

Kent Schmidt, v. KMS Retail-Ben White, LPKMS Retail Euless, LA, Kent Stainback, d/b/a The Stainback Organization, Pete Becerra, Jimmy Evans Company, Ltd., In The District Court, 345th Judicial District, Travis County, Texas, deposition testimony August 2009

Howard Hopkins et al, v. The First American Corporation And First American Real Estate Tax Service, In The United States District Court Of Texas, Fort Worth Division, deposition testimony July 2009

Westin Casuarina Las Vegas, Hotel, Casino & Spa v. The Coaching Center, LLC, Before The American Arbitration Association, Arbitration meeting June 2009

Billy Ray Tratree v. B.P. Pipelines, Inc., Kelley Gleason and Roy Bowden, in the United States District Court for the Southern District of Texas, deposition testimony June 2009

Kent Schmidt, v. KMS Retail-Ben White, LPKMS Retail Euless, LA, Kent Stainback, d/b/a The Stainback Organization, Pete Becerra, Jimmy Evans Company, Ltd., In The District Court, 345th Judicial District, Travis County, Texas, deposition testimony May 2009

Juan Manual Lopez-Verduzco, v. CTNA, et al Arizona Superior Court, County Of Maricopa, deposition testimony April 2009

James J. Byerlotzer v. Key Energy Services, Inc., In The District Court Of Harris County, Texas 55Th Judicial District, deposition testimony March 2009

David Liszt and Karen Liszt v. Richard B. Stovall, MD.; Luis Mignucci, MD., Individually and d/b/a Luis Mignucci, MD., P.A., and d/b/a NeuroSpine Surgical Consultants; and Medical Center of Plano; In the 219th District Court of Collin County, Texas, deposition testimony March 2009

Marie Popek, Individually and on Behalf of Those Similarly Situated, v. Allied Barton Security Services LLC, a Delaware Limited Liability Company; Allied Barton Security Services LP, a Delaware Limited Partnership; and Does 1 through 30, inclusive, Superior Court of the State of California for the County of San Francisco, CA., deposition testimony December 2008

Charles Heath Leiber v. IE Miller Service L.P., IE Miller-Fowler L.L.C., and Noah Charles Lawson, In the District Court 12th Judicial District of Grimes County, Texas, deposition testimony November 2008

Billy Ray Tratree v. B.P. Pipelines, Inc., Kelley Gleason and Roy Bowden, in the United States District Court for the Southern District of Texas, deposition testimony November 2008

Doris H. Gray, a married woman, v. Motorola, Inc., a Delaware Corporation, In the Superior Court in and for Maricopa County in the State of Arizona, deposition testimony November 2008

Fred Klecka v. Allstate Insurance Company and Kathleen Abed, In The District Court 37th Judicial District, Bexar County, Texas, trial testimony November 2008

Esteban Barron v. Larry Paul Hatter, Jr., And Estes Express Lines d/b/a Estes Express Lines, Inc., In The District Court, 146Th Judicial District, Bell County, Texas, deposition testimony October, 2008

UNIVAR USA, Inc., v. Stacey B. Blanton, In The District Court Harris County, Texas 61st Judicial District, deposition testimony August 2008

Pedro Gonzalez v. City Of San Antonio, Acting By And Through Its Agent, City Public Service Board d/b/a CPS Energy, In The District Court 225th Judicial District Bexar County, trial testimony, San Antonio, Texas August 2008

Charles Young v. Brand Scaffold Services, LLC, In the Eastern District Court for the Eastern District of Texas, Beaumont Division, deposition testimony June 2008.

Al Scott, Individually And As Administrator Of The Estate Of Dottie Scott, Deceased, And Susan Scott And Sherri Scott v. Sandip V.Mathur, M.D. and Abilene Regional Medical Center In The 42nd Judicial District Court of Taylor County Texas, deposition testimony April 2008

International Association Of Firefighters, LOCAL 629 AFL-CIO, et al v. City Of Monroe, in the United States District Court, Western District Of Louisiana, Monroe Division, deposition testimony March 2008

Jennifer Jarmon and, Cassius Jarmon, Individually and as Co-Administrators of the estate of Cassidy Jarmon, Deceased, and as Next Friends to Callie Jarmon, a minor child v. Delbert J. Davison, Old American County Mutual, Prine Towing and Recovery, Inc. COPART, Inc., and Daimler Chrysler Corporation, In the District Court, 412th Judicial District, Johnson County, Texas, deposition testimony February 2008

Veronica Ramirez Aguilar, Individually, as representative of the estate of Mario Islas Minero, and on behalf of all wrongful death beneficiaries v. Heart Employee Leasing, Inc. D/B/A and Heart HR, and S and D Plumbing- Taylor LLC, In the District Court of Travis County, Texas, 353rd Judicial District, deposition testimony January 2008

Rolando Garcia v. Design Werks, Inc., In the District Court of Travis County, 98th Judicial District, deposition testimony January 2008

Wilford Vogt, James P. Gauthier, and Humberto Reyna, Jr., for themselves and all others similarly-situated United States District Court, for the Northern District Of Texas Dallas, Dallas Division v. Texas Instruments Incorporated, deposition testimony November 2007

Randall Barnett, In The District Court, 353RD Judicial District v. City Of Austin, Powell Austin Properties, Ltd., Powell Holdings, Inc., Makota, Inc., and Alejandro Herrera, Travis County, Texas, deposition testimony November 2007

Cynthia S. Escamilla v. United Services Automobile Association, a Reciprocal, and Michael Barry, arbitration November 2007

Cynthia S. Escamilla v. United Services Automobile Association, a Reciprocal, and Michael Barry, deposition testimony October 2007

Jesus F. Diaz, Individually, as next friend of Marco A. Montoya and Racquel A. Diaz, minors and as dependent Co-Administrator of the Estate of Maria E. Diaz; James L. Caldwell, as dependent Co-Administrator of the Estate of Maria E. Diaz; Alejandro E. Diaz' and Isidora Gonzales v. General Motors Company, Autonation USA d/b/a Champion Chevrolet, H. E. Butt Grocery Company and Gilbert E. Delgado III in the Probate Court, Travis County Texas, deposition testimony August 2007

Angela Kay Warden, and husband, Brent Warden v. Wendell B. Ashby, MD, In The 108th District Court, Potter County, Texas, trial testimony May 2007

Angela Kay Warden, and husband, Brent Warden v. Wendell B. Ashby, MD, In The 108th District Court, Potter County, Texas, deposition testimony May 2007

William Montano and Doris Lucero v. Christmas By Krebs Corp., In The United States District Court For The District Of New Mexico, deposition testimony March 2007

Daniel J. Davis, III and Yvonne Davis v. Worthy Warnack, M.D., Britt T. Daniel, M.D. and Margaret Hollar, D.O.; In the District Court Dallas County, Texas 95th Judicial District, deposition testimony February 2007

Julian James, Individually, Daphne Bates Harrison, et al. v. Harris County Sheriff's Department, et al, In the United States Court for the Southern District of Texas, Houston Division, trial testimony January 2007

Sheila K. Robinson, Plaintiff, in the District Court of Brazos County, Texas v. Texas A&M University, Defendant in the 85th Judicial District, College Station, Texas, trial testimony January 2007

Viridiana Mata, Individually and Alejandro Rodriguez Individually, and all on Behalf of Genoveva Rodriguez, a Minor v. Mission Hospital and Heather A. Daley, M.D. 370th Judicial District in the District Court of Hidalgo County, Texas, deposition testimony December 2006

Billy Ray Tratree v. B.P. Pipelines, Inc.; In the United States District Court for the Southern District of Texas Houston Division, trial testimony October 2006

Julian James, Individually; Daphne Bates Harrison, Individually, et al. v. Harris County Sheriff's Department and William Wilkinson; In the United States District Court for the Southern District of Texas Houston Division, deposition October 2006

Texas Health and Human Services Commission, Medicaid and other Health and Human Services Fraud and Abuse Program Integrity - Legal Action Relating to Dr. Turner Lewis, M.D., administrative hearing September 2006

Billy Ray Tratree v. B.P. Pipelines, Inc.; In the United States District Court for the Southern District of Texas Houston Division, trial testimony August 2006

Julian James, Individually, Daphne Bates Harrison, et al., v. Harris County Sheriff's Department, et al, In the United States Court for the Southern District of Texas, Houston Division, testimony deposition March 2006

Michael Gibson v. Ondeo Nalco Energy Services, Inc. and Ondeo Nalco Company In the United States District Court for the Southern District of Texas, Houston Division, trial testimony February 2006

Frederick L. Risker v. Mahnaz Naveed Shah, M.D., Kelsey –Seybold Medical Group, P.A., and Gramercy Surgery Center, Ltd. D/B/A Gramercy Outpatient Surgery Center, deposition testimony November 2005

Larry Butler and Cathy Butler, Individually and on Behalf of Brittany Butler, a minor, and Erin Ferguson v. Kyle Kennedy, Russell Kennedy, Randi K. Kennedy, and Dana Harris, deposition testimony September 2005

Cheryl Smith, Individually and as Guardian and Next Friend of Michelle Smith, an Incapacitated Person v. Reyna Jean Noble, Ross Road Boring, Co., and Bobby L. Lambright, and Mark Huber, Individually and on Behalf of Jessica Huber, A Minor v. Ross Road Boring, Co., and Bobby L. Lambright, deposition and trial testimony August 2005

Amy Adkins v. Futurion Associates, Inc., deposition testimony August 2005

Jennifer Passi, Individually and a/n/f of Gracelyn Ann and Grant Michael Passi, Minor Children and as Representative of the Estate of Michael Vincent Passi, deceased v. Dr. Emery W. Dilling and Dr. Staton L. Awtrey; In Travis County, Texas, deposition testimony August 2005

Tanya Valdez, as next friend of Alejandro Ruben Pando, a minor and Lelia Alvarez, Individually and as representative of the estate of Ruben Pando, Jr., deceased v. Brinker Texas, L.P. D/B/A On The Border Mexican Grill & Cantina, Brinker Chili's Texas, Inc. D/B/A On The Border Mexican Café, Brinker International, Inc, Chili's Beverage Company, Inc., and Marlene Muniz as independent administrative and personal representative of the estate of Felipe Ornelas, Jr., deposition testimony 2005

Vanessa Sinegaure, Individually and as a Representative of the Estate of Darnell Eugene Sineguare v. Bally Total Fitness Corporation, et al; In the 334th Judicial District Court, Harris County, Texas, deposition and trial testimony 2005

Jerry L. Bigelow, Individually and as Next Friend of B.B., J.N.B., J.T.B. and S.B., Minors v. Living Picture AG, Living Picture Ltd., Living Picture GmbH and New York Lighter Co., Inc.; U.S. District Court, Western District of Texas, Austin Division, deposition testimony 2005

Suresh Dutta v. David Pistenmaa, In the United States District Court for the Northern District of Texas, Dallas Division, deposition and trial testimony 2005

Carrie Bennett, Individually as Representative of the Estate of Roy Edward Bennett, Deceased, and as Next Friend of Lane Edward Bennett, Cody Lee Bennett and April Anne Bennett v. Stephens Martin Paving, LP, Mobile Products, Inc. D/B/A Lay-Mor ; In the District Court, Taylor County, Texas, 42nd Judicial District, deposition testimony 2005

Robert Edwin Wills v. Sysco Food Services of Austin, L.P. and Rickey Charles Green In the 82nd Judicial District Court of Robertson County, Texas, deposition testimony 2005

Michael Gibson v. Ondo Nalco Energy Services, Inc. and Ondo Nalco Company; In the United States District Court for the Southern District of Texas, Houston Division, deposition testimony 2005

Regina Kelly, et al. v. John Paschall et al.; In the United States District Court for the Western District of Texas; Waco Division, deposition testimony 2004 and 2005

Charles White v. Technip USA Corporation and Technip, Inc.; In the 11th Judicial District Court of Harris County, Texas, deposition testimony 2005

Mike Arismendez and Elva Arismendez v. Covenant Health Systems d/b/a Covenant Medical Center; In the 237th District Court of Lubbock County, Texas, deposition testimony 2005

Linda Webb, Individually and on behalf of others similarly situated, v. Barnes Group Inc States District Court, Northern District of Texas, Dallas Division; Consolidated Case No. 3-02CV2716-Rm class certification 2004

Margia Blankenship, et al. v. Marathon Oil, In the District Court of Harris County 281st Judicial District, class certification 2004

Margia Blankenship, et al. v. Marathon Oil, In the District Court of Harris County 281st Judicial District, deposition testimony 2004

Janet Herdman, et al. v. El Paso Energy Corporation et al., In the District Court of Harris County, Texas 234 Judicial District, deposition testimony 2004

Sylvia Garcia and Rachel Garcia, Individually and on Behalf of the Estate of Richard Garcia, Deceased v. Ted L. Phipps, M.D. and The Lubbock Digestive Disease Associates, P.A. and Covenant Health Systems d/b/a Covenant Medical Center In The 237th District Court of Lubbock County, Texas, deposition testimony 2004

Benavides v. Cushman et al, In the District Court of Harris County, Texas; 280th Judicial District, trial testimony 2004

Jason Malone v. D.R. Horton – Emerald, Ltd.; In the 129th Judicial District Court of Harris County, Texas, deposition testimony 2003

Donald Castleberry and Mary Castleberry v. R. Douglas Mills, M.D., Nurse Jane Doe, St. David's Healthcare System, L.P. d/b/a North Austin Medical Center and Capital Emergency Associates; In The 353rd Judicial District Court of Travis County, Texas, deposition testimony 2003

Hammer Trucking, Inc. v. St. Paul Fire and Marine Insurance Company, et al.; In the 271st Judicial District Court of Wise County, Texas, deposition testimony 2003

Rodney Wayne Hurt, M.D. v. Southwest Lincoln Mercury, deposition testimony 2003

Juan T. Gonzales v. S & B Engineers and Contractors, Ltd.; In the District Court of Harris County, Texas; 280th Judicial District, deposition testimony 2003

John McKelvey and Lawanda McKelvey v. Arctic Pipe Inspection, Inc.; In the 333rd Judicial District Court, Harris County, Texas, deposition testimony 2003

Gwendolyn Mason v. American Electric Power/Central Power and Light Company, In the United States District Court, Western District, deposition testimony 2003

Linda Webb, Individually and on behalf of others similarly situated, v. Barnes Group Inc States District Court, Northern District of Texas, Dallas Division; Consolidated Case No. 3-02CV2716-R deposition testimony 2003

Clawson v. Michael Landess and Covert Ford; In the district court of Travis County, Texas, 345th judicial district, deposition testimony 2003

Juan T. Gonzales v. S & B Engineers and Contractors, Ltd.; In the District Court of Harris County, Texas; 280th Judicial District, trial testimony 2003

Benavides v. Cushman et al, In the District Court of Harris County, Texas; 280th Judicial District, trial testimony 2003

Gwendolyn Mason v. American Electric Power/Central Power and Light Company, In the United States District Court, Western District, trial testimony 2003

Mandy De Leon v. Ivan Melendez, M.D et al., In the District Court, Hidalgo County, Texas, 332nd Judicial District, deposition testimony 2002

Nicole Terry, et al. v. Qwest Communications, Inc., Santos Ruiz Castillo, and Hertz Equipment Rental, Inc.; In the 82nd District Court of Robertson County, Texas, deposition testimony 2002

Maria Hilda Rodriguez v. Emerson Electric Co et al., In the United States District Court for the Southern District of Texas, McAllen Division, deposition testimony 2002

In Re: Ambrocio Suarez, Jr., Deceased; In the Probate Court #2 of Harris County, Texas, deposition testimony 2002

Robert L. Hunt and Lisa S. Hunt v. Century 21 Ripley Realty, Robert H. Carroll and Sylvia K. Carroll; in the District Court Williamson County, Texas, 26th Judicial District, deposition testimony 2002

Marcelyn K. Boone, Individually, and on behalf of similarly situated persons, Plaintiff v. Union Carbide Corporation, Defendant; United States District Court, Southern District of Texas, Galveston Division, deposition testimony 2002

Thomas J. Galland v. David L. Winn; In the District Court of Williamson County, Texas, 368th Judicial District, deposition testimony 2002

Tranquilino C. Munoz v. Newtron, Inc. and John Grant, In the District Court, Jefferson County, Texas 60th Judicial District, deposition testimony 2002

Kirk Chi v. Dell Computer Corporation; In the United States District Court, Western District of Texas, deposition testimony 2002

Pablo Reyes v. Glesby Marks Corporation; Atlas Air Conditioning Company, L.P.; Comfort Systems U.S.A., Inc.; Atlas-Accurate Holdings, L.L.C. and John Bolan; In the District Court of Harris County, Texas, 189th Judicial District, deposition testimony 2002

Gwendolyn Mason v. American Electric Power/Central Power and Light Company; In the Southern District of Texas, Corpus Christi Division, deposition and trial testimony 2002

Dario Ibarra v. Pat Haas, d/b/a Patrick Haas Construction and Barton Creek Lakeside, LLC, in the 345th Judicial District Court of Travis County, Texas, Personal Injury, deposition testimony 2002

Benavides v. Cushman et al, In the District Court of Harris County, Texas; 280th Judicial District, deposition testimony 2002

Alcatel USA, Inc. v. Cisco Systems, Inc., In the United States District Court for the Eastern District of Texas, Sherman Division, deposition testimony 2002

Thomas J. Galland v. David L. Winn; In the District Court of Williamson County, Texas, 368th Judicial District, trial testimony 2002

Mandy De Leon v. Ivan Melendez, M.D et al., In the District Court, Hidalgo County, Texas, 332nd Judicial District, trial testimony 2002

Juanita Fletcher v. City of Houston, In the 189th Judicial District Court, Harris County, Texas, trial testimony 2002

Keith Ferrell and Tracey Ware v Robert Robinson and the City of Houston, In the County Civil Court at Law Number One, Harris County, Texas, deposition testimony 2001

Barbara LaRoche v. Daughters of Charity Health Services of Austin, et al, In the 126th Judicial District Court of Travis County, Texas deposition testimony 2001

Brandenburg v. Georgetown Independent School District, United States District Court, Western District of Texas, trial testimony 2001

EEOC v. BP Amoco et al., In the United States District Court for the Southern District of Texas, Houston Division, deposition testimony 2000

Gomez v. United Parcel Service, United States District Court, Western District of Texas, deposition testimony 2000

Pineda v. The City of Houston, In the United States District Court for the Southern District of Texas, Houston Division, deposition testimony 2000

McDonald v. Dr. Sophia Burns, M.D., 268th District Court Fort Bend County, Texas, deposition testimony 2000

Michelle Toussaint v. Sonic Restaurant, In the 136th District Court of Jefferson County, Texas, deposition testimony 2000

Woolf v. Vincent, M.D., 9th District Court, Polk County Texas, deposition testimony 2000

Isaac Robinson as Next Friend of Chasity Amanda Robinson, Arizona Jackson and Earlean Murray, as Executive of the Estate of Ruby McDonald v. Dr. Sophia Burns, M.D. 268th District Court Fort Bend County, Texas, deposition testimony 2000

Olen Lovell III v. Texas Health Resources, Herman Methodist System, Arbitration Cause No. 1310010565, Dallas, Texas, arbitration 1999

Walker et al v. Facility Insurance Corporation, et al, In the District Court of Travis County, Texas 98th Judicial District, deposition testimony 1999

Milton Santiago v. American Airlines, Inc., In the 191st Judicial District Court, Dallas County, Texas, deposition testimony 1999

Brown v. Sysco, Inc., United States District Court, Western District of Texas, deposition testimony 1999

Walker et al v. Facility Insurance Corporation, et al, In the District Court of Travis County, Texas 98th Judicial District, Robinson/Daubert hearing testimony 1999

Mato v. Dr. Jack Baldauf, et.al, United States District Court, Western District of Texas, Austin, trial testimony 1999

Goode v. City of Austin and Fine Host Corp, United States District Court, Western District of Texas, deposition testimony 1998

Chambers v. Texas A&M et al., United States District Court, Western District of Texas, deposition testimony 1998

Chambers v. Texas A&M et al., United States District Court, Western District of Texas, trial testimony
1998

INVITED PRESENTATIONS AND PUBLIC SPEAKING ENGAGEMENTS

Eastern Economics Association Conference, “Risk Shifting by Employee Terminations and Layoffs”, Discussant, New York City February 2017

American Economics Association Annual Meeting, “Pitfalls of Forensic Economic Analysis: Employment”, San Francisco, California, January 3, 2016.

Eastern Economics Association Conference, “Extending the Econometric Model of Worklife Expectancy”, New York, New York, February 27, 2015.

Employment Law CLE, “What is wrong with this paycheck? Investigating allegations of FSLA and wage and hour violations using payroll, time and personnel records”, San Francisco, California, March 6, 2014

Employment Law CLE, “What is wrong with this paycheck? Investigating allegations of FSLA and wage and hour violations using payroll, time and personnel records”, Oakland, California, March 5, 2014

Employment Law CLE, “What is wrong with this paycheck? Investigating allegations of FSLA and wage and hour violations using payroll, time and personnel records”, Century City, California, January 30, 2014

Fulbright & Jaworski LLP, “Use of Economic Experts in Employment Litigation”, Houston, Texas, April 18, 2013

Southern Economic Association Conference, “Economic Damage Valuations in South Africa”, New Orleans, Louisiana, November 17, 2012

Houston Bar Association, Employment Section “Back Pay and Front Pay Calculations in Employment Termination”, Houston, Texas, March 12, 2012

Allied Social Science Association Conference, Forensic Economics II “Household Services Production in Mexico”, Chicago, Illinois, January 7, 2012

Texas Labor & Employee Relations Consortium hosted by CenterPoint Energy, “Employee Labor Unions and EEO Compliance”, Houston, Texas, June 9, 2011

Allied Social Science Association Conference, “Using Economic, Statistical and Time Clock Evidence in Wage and Hour and Employment Lawsuits”, Chicago, Illinois, April 2011

Employment Law CLE, “Using Economic, Statistical and Time Clock Evidence in Wage and Hour and Employment Lawsuits”, San Francisco, California, March 4, 2011

Southern Economic Association Conference, “Calculating Economic Damages for Previously Incarcerated Individuals”, Atlanta, Georgia, November 21, 2010

Employment Law CLE, “Using Economic, Statistical and Time Clock Evidence in Wage and Hour and Employment Lawsuits”, Houston, Texas, October 21, 2010

Dallas Bar Association’s Friday Clinic, “Valuing Economic Damages in Injury, Wrongful Death and Employment Cases”, Dallas, Texas, September 10, 2010

American Association of Justice Annual Convention, “Evaluating Damages for the Incarcerated”, Vancouver, Canada, July 2010

Academy of Economics and Finance, 37th Annual Meetings, “Valuing Employee Stock Options in a Breach of Contract Case”, Houston, Texas, February 2010

American Economic Association Meetings, “Valuing Employee Stock Options in a Breach of Contract Case”, Atlanta, Georgia, January 2010

Capital Area Paralegal Association CLE, “Valuing Economic Damages in Injury, Wrongful Death and Employment Cases”, Austin, Texas, October 28, 2009

UT CLE, The 15th Annual Labor and Employment Law Conference, Austin, Texas, May 29 - 30, 2008

NAACP 71st Texas Annual meeting, “Police Use of Force and Racial Profiling Panel Discussion”, McAllen, Texas, October 12, 2007

Western Economic Association International, Chairperson of Employment Discrimination and Wage and Hour Analysis Sessions, Seattle, Washington, June 29 – July 1, 2007

UT School of Law 14th Annual Employment Law CLE, Presented with Stephanie Botello, “Calculating, Proving, and Mitigating Damages Involving Re-employment”, Austin, Texas, May 17, 2007

Iowa Economic Alumni Workshop, Tippie College of Business, “How Long do Mexican Migrants Work in the U.S.?”, Iowa City, Iowa, April 21, 2007

Trialsmith CLE webinar series, “Calculating Economic Damages in Injury and Death Cases”, February 8, 2007

American Economic Association Annual Meeting, Session Chairperson, “Economic Issues in Estimating Damages in Commercial and Personal Injury Cases”, Chicago, Illinois, January 6, 2007

MADD National Diversity Forum II, speaker for “Profiling to Behavior” a moderated panel discussion, Dallas, Texas, May 16 – 18, 2006

Academy of Economics and Finance Meeting, “Valuing Employee Stock Option Grants in Litigation”, Houston, Texas, February 10, 2006

American Economic Association Annual Meeting, “Estimating the Work Life Expectancy of Undocumented Mexican Migrant Workers”, Boston, Massachusetts, January 2006

DRI 2005 Annual Meeting, speaker for employment law “Lies, Damn Lies, and Employment Statistics”, Chicago, Illinois, October 21, 2005

Labor and Employment Roundtable, sponsored by Texas Lawyer, August 31, 2005

Austin Business District Roundtable, ‘Economic Roundtable on the Future of the Austin and Texas Economy’, July, 2005

Iowa Alumni Workshop, Department of Economics, Tippie College of Business: “Economics and Economists in the U.S. Legal System: A View from the Trenches”, University of Iowa, April, 2005

Police Executive Research Forum: “Data Analysis Guidelines for Poststop Analyses”, Las Vegas and Kansas City; 2004

Texas State Capitol Media Press Conference – Study Release, “An Examination of Consent Searches and Contraband Hit Rates at Texas Traffic Stops”, Austin, Texas, 2005

Police Executive Research Forum, Racial Profiling Meeting: Denominator Conference, “Use of Census Data to Measure Racial Disparities in Traffic Stops”, Las Vegas, Nevada, 2004

Austin City Council Meeting, West University Area Rezoning, “Rezoning Austin’s West Campus, A Unique Opportunity for Smart Growth”, Austin, Texas, 2004

African-American Economic Legislative Forum, Hosted by Representative Senfronia Thompson, Roundtable Speaker, Texas State Capitol, Austin, Texas, 2004

North Texas Police Racial Profiling Conference, The University of Texas at Arlington, Center for Mexican American Studies, “The 2002 Racial Profiling Data Revisited: A Look to the Future”, Arlington, Texas 2004

NAACP and LULAC Police - Community Town Hall Meeting, “A Look at Police Racial

Profiling Statistics in Fort Worth, Fort Worth, Texas, 2004

NAACP and LULAC Police - Community Town Hall Meeting, “A Look at Police Racial Profiling Statistics in Beaumont, Beaumont, Texas, 2004

NAACP and LULAC Police - Community Town Hall Meeting, “A Look at Police Racial Profiling Statistics in Houston, Houston, Texas, 2004

Texas State Capitol, Senator Royce West Legislative Roundtable of Police Racial Profiling Data Collection and SB 1074, Roundtable Speaker, Austin, Texas, 2004

Police - Community Relation Forum, “A Preliminary Look at Racial Profiling in Texas and the Huntsville Area”, Huntsville, Texas, 2003

Economic Issues in the African-American Forum, “The Roots of African-American Economic Progress”, Radio Program, KAZI, Austin, Texas 2003

Texas State Bar Advanced Employment Law CLE Seminar, “Lies, Damn Lies, and Statistics”, Houston, Texas, 2003

Haynes and Boone, LLP, “Use and [Misuse] of Economics in Economic Damage Calculations”, Austin, Texas, 2002

Texas Police Chief Forum on Racial Profiling, “Using Search Data and Stop Data to Measure Racial Profiling”, University of Texas at Austin, Austin, Texas, 2002

Texas State Capitol Press Conference - Study Release, “Selecting Racially Balanced Texas Juries”, Austin, Texas, 2003

Texas State Capitol, Press Conference-Study Release, “Cost savings and Efficiency in the Texas State Criminal Justice System”, Austin, Texas, 2003

PowerCenter, “Drug treatment programs and Cost Savings in Texas”, Houston, Texas, 2003

Texas State Senate Chambers, “Statistical Analysis of Police Racial Profiling Data”, Austin, Texas 2001

This Week with Senator West, Television show, Roundtable Discussion, Topic: “Detecting Racial Profiling”, Austin, Texas 2001

Texas State Capitol, Media Press Conference, “Release of NAACP Police Racial Profiling Study”, Austin, Texas, 2000

College of Business Administration, Sam Houston State University, “Lending Discrimination”, Huntsville, Texas 1998

Federal Reserve Bank of Chicago; Moderator, “Detecting Lending Discrimination in Credit Markets”, Chicago, Illinois, 1997

Federal Reserve Board, “Bank Mergers and Managerial Efficiency”, Washington D.C, 1995

PUBLIC TECHNICAL REPORTS, PUBLICATIONS AND WORKING PAPERS

“Statistical Analysis of Employment Data in Discrimination Lawsuits and EEO Audits: A statistical guide for attorneys, human resource professionals and EEO compliance personnel”, Econometrics Publishing, February 2010

“Back Pay and Front Pay Calculations in Employment Termination Cases: Accounting for re-employment and mitigation efforts” (Joint with Stephanie Botello, Ph.D.), 2008, available at Social Science Research Network

“Economic Damages Primer for Attorneys: The building blocks for valuing economic damages in personal injury, wrongful death, medical malpractice, and products liability cases”, (Joint with Charles Mahla, Ph.D., Michael Sadler, Ph.D., Chad Shirley, Ph.D., Doug Berg, Ph.D., et al.), Econ One Research, Inc., September 2007

"How Long do Mexican Migrants Work in the U.S.?" (Joint with Amy Raub and Jeannie Elliott), Journal of Forensic Economics, Volume XIX No. 2

“Evaluating the Statistical and Economic Significance of Statistical Evidence in Employment Discrimination Cases, Expert Evidence Report”, The Bureau of National Affairs, Inc., Vol. 5, No. 5; p. 117-119; March 7, 2005 and March 23, 2005

“Racial Differences in Interest Rates”, Midwestern Business and Economic Review, p. 9 – 24, Number 34, Fall 2004

“Lies, Damn Lies, and Statistics: A View from a Statistical Expert”, Texas State Bar Advanced Employment Law CLE Chapter 13.1, 2003

“Evaluating Statistical Evidence in Employment Discrimination Cases”, Expert Evidence Report, Bureau of National Affairs, p. 117-119.

“An Examination of Consent Searches and Contraband Hit Rates at Texas Traffic Stops”, (Co-Authored) Technical Report Prepared for NAACP, LULAC, and Texas Criminal Justice Reform Coalition 2005

“Racial Profiling: Texas Traffic Stops and Searches; A first look at the nation’s most comprehensive racial profiling dataset”, (Co-Authored) Technical Report Prepared for NAACP, LULAC, and Texas Criminal Justice Reform Coalition, 2004

“Re-Zoning Austin’s West Campus: A Unique Opportunity for Smart Growth”, Technical Report Prepared for the University Area Partners, 2004

“Drug Treatment Programs and Cost Savings in the Texas State Criminal Justice System”, Technical Report Prepared for Justice Policy Institute and NAACP Voter Fund, 2003

“A Statistical Methodology to Help Courts Select Racially Balanced Texas Juries”, Technical Report Prepared for the NAACP, 2003

“A5/2/2012Re-examination of Police Racial Profiling Using the Becker Model of Discrimination”, co-authors Doug Berg and John Maroney, Working paper, 2002

“A Fixed-Effects Discrete Choice Model of Racial Profiling in Police Vehicle Searches”, Working Paper, 2002

“A Preliminary Examination of Racial Profiling in Texas: A look at Police Search Rates in Texas”, (Co-Authored), Technical Report Prepared for the NAACP, 2000

“A Note: Bootstrap Standard Errors and Confidence Intervals for Weak Axiom of Cost Minimization (WACM) Based Managerial Efficiency Estimates”, Published Applied Economics Letters V.2., 1998

“Bank Mergers and Cost Efficiency”, Ph.D. Dissertation, University of Iowa, 1995

“Racial Differences in Interest Rates: A Cluster Analysis Approach”, Co-authors Doug Berg and Donald Bumpass (SHSU) (2002), Paper accepted for presentation at Economics and Finance Association, February 2003 meeting in Savannah, Georgia.



Employment | Wage and Hour | Economic Damages

Fee Schedule

<u>Personnel</u>	<u>Hourly Rate</u>
D. Steward	\$595
Economists (Ph.D. level)	\$275 - \$325
Senior Analysts (experienced BA and MA/MS level)	\$250
Analysts	\$195
Clerical and General Research Assistance	\$50 - \$75

www.employstats.com

Effective November 7, 2017

Exhibit B: Documents

Num. Description

1.	[Arrest Warrant Data (4-17-2018)]/Jaildocket 01012012-09202017.csv
2.	[Arrest Warrant Data (4-17-2018)]/Justice Court warrant arrest 1 from 01012012.csv
3.	[Arrest Warrant Data (4-17-2018)]/Justice Court warrant arrest 2 from 01012012.csv
4.	[Arrest Warrant Data (4-17-2018)]/Warrant Module 01012012-09202017.csv
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168.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Census Data]/[ACS_2016_5YR_PLACE]/ACS_16_5YR_DP05_with_ann.csv
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187.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Census Data]/[ACS_5YR_TRACT_EMPLOYMENT]/ACS_12_5YR_S2301_metadata.csv
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252.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[1_raw_data_files]/2_Roadblock Locations (Handwritten).xlsx
253.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[1_raw_data_files]/3_Unlisted Roadblocks.xlsx
254.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[2_cleaned_addresses]/1_Raw CAD Data and Clean Address Tab.xlsx
255.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[2_cleaned_addresses]/2_Roadblock Locations (Handwritten) - Raw Data and Formatted For R.xlsx
256.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting

	Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[2_cleaned_addresses]/3_Unlisted Roadblocks - Raw Data and Formatted For R.xlsx
257.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[3_unique_addresses_geocoding_input]/1_Unique List of Clean Addresses From CAD.csv
258.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[3_unique_addresses_geocoding_input]/2_ROAD~1.XLS
259.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[3_unique_addresses_geocoding_input]/3_Unlisted Roadblocks - Unique List of Addresses.xlsx
260.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[4_geocoding_output]/1_Geographic Coordinates For CAD Addresses.csv
261.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[4_geocoding_output]/2_Geographic Coordinates for Roadblock Locations (Handwritten).xlsx
262.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Roadblock Data]/[4_geocoding_output]/3_Geographic Coordinates for Unlisted Roadblocks.csv
263.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Shape Files]/[ACS_2015_5YR_TRACT_28_MISSISSIPPI.gdb]/a00000001.freelist
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378.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Shape Files]/[ACS_2015_5YR_TRACT_28_MISSISSIPPI.gdb]/a00000022.gdbindexes
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406.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[1. input]/[Shape Files]/[tl_2017_28_place]/tl_2017_28_place.shp.iso.xml
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410.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/CAD_Roadblocks_Mapped.csv
411.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/Census_Data.csv
412.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/Handwritten_Roadblocks_Mapped.csv
413.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/Imputed_Roadblocks_Mapped.csv
414.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/n_roadblocks_by_tract.sas7bdat
415.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/Number Of Roadblocks Per Location - For R.xlsx
416.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/regression_input.dta
417.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/Roadblocks Per Capita - Per Census Tract Group.xlsx
418.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/roadblocks_census_CAD.csv
419.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/unique_roadblocks.sas7bdat
420.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/Weighted Average Black Population Percentage 2012 to 2017 Per Census Tract.csv
421.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[2. Datasets]/Weighted Average Black Population Percentage Per Census Tract Group.csv
422.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[3. Output]/Appendix_C.xml
423.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[3. Output]/Exhibit 2.pdf
424.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting

	Materials]/[Expert Report Production File]/[data]/[3. Output]/Exhibit 3 - Map Without Text Boxes - From R.pdf
425.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[3. Output]/Exhibit 4.pdf
426.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[data]/[3. Output]/Exhibit_6.xml
427.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[Exhibits and Appendices]/Appendix C.xlsx
428.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[Exhibits and Appendices]/Exhibit 2.pdf
429.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[Exhibits and Appendices]/Exhibit 3.pdf
430.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[Exhibits and Appendices]/Exhibit 4.pdf
431.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[Exhibits and Appendices]/Exhibit 6.xlsx
432.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[Exhibits and Appendices]/Exhibits 1, 5.xlsx
433.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[Exhibits and Appendices]/Exhibits 1, 5.xlsx
434.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[Other]/Sobriety Checkpoint & Roadblock Policy.pdf
435.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/[Expert Report Production File]/[Publicly Available Sources]/US Census Bureau - Madison County Census Tract Map.pdf
436.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/Ricchetti Report Appendices.pdf
437.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/Ricchetti Report Exhibits.pdf
438.	[Class Certification 03142018]/[Expert Disclosures]/[Expert Report and Supporting Materials]/Ricchetti Report.pdf
439.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Code]/1. Import arrest data.sas
440.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Code]/2. Analyze arrest data.sas
441.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Code]/3. Import citations raw data and categorization.sas
442.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Code]/4. Analyze citations data.sas
443.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting

	materials]/[FRE 1006 Production File]/[Code]/5. Import and analyze incident report parsed results.sas
444.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Code]/header.sas
445.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[1. Input]/ACLU FOIA Request 02052018 V1.xlsx
446.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[1. Input]/ACLU12TO17.CSV
447.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[1. Input]/parsed_results.xlsx
448.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[1. Input]/Seatbelt Search - Flagging - For SAS.xlsx
449.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[2. Datasets]/aclu_foia_request_02052018.sas7bdat
450.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[2. Datasets]/arrests_raw.sas7bdat
451.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[2. Datasets]/categories_for_citations.sas7bdat
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454.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[2. Datasets]/Seatbelt Search - Flagging - For SAS.xlsx
455.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[3. Output]/Incident Report Apartment Walkthroughs - From SAS.xlsx
456.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[3. Output]/Incident Report Roadblock Arrests - From SAS.xlsx
457.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[3. Output]/Incident Report Traffic Stops - From SAS.xlsx
458.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[3. Output]/Incident Report Traffic Stops Seatbelt Violation - From SAS.xlsx
459.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[3. Output]/Individuals Cited For Seatbelt Violation Only - From SAS.xlsx

460.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[3. Output]/Summary of Arrests by Offense Code - From SAS.xlsx
461.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[3. Output]/Summary of Citations by Violation Category - From SAS.xlsx
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463.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Data]/[3. Output]/Summary of Total Citations - From SAS.xlsx
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465.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Exhibits and Appendices]/[Excel]/Arrests From Incident Reports Related to Apartment Walkthroughs.xlsx
466.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Exhibits and Appendices]/[Excel]/Arrests From Incident Reports Related to Stops at Roadblocks.xlsx
467.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Exhibits and Appendices]/[Excel]/Arrests From Incident Reports Related to Traffic Stops.xlsx
468.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Exhibits and Appendices]/[Excel]/Black Percentage of Arrests by Offense Code.xlsx
469.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Exhibits and Appendices]/[Excel]/Black Percentage of Citations and Summary of Citations by Violation Category.xlsx
470.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Exhibits and Appendices]/[Excel]/Individuals Cited For Seatbelt Violation Only.xlsx
471.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Exhibits and Appendices]/[Excel]/Summary of Arrests by Offense Code.xlsx
472.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Exhibits and Appendices]/[Excel]/Summary of Total Arrests.xlsx
473.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/[FRE 1006 Production File]/[Exhibits and Appendices]/[Excel]/Summary of Total Citations.xlsx
474.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting

	materials]/[FRE 1006 Production File]/[Publicly Available Sources]/US Census Bureau QuickFacts - Madison County, Mississippi.pdf
475.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/Guha Declaration Appendices.pdf
476.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/Guha Declaration Exhibits.pdf
477.	[Class Certification 03142018]/[Expert Disclosures]/[fre 1006 declaration and supporting materials]/Guha Summary Declaration.pdf
478.	[Class Certification 03142018]/[Pleadings]/231 Plaintiffs' Motion for Class Certification.pdf
479.	[Class Certification 03142018]/[Pleadings]/231-1.pdf
480.	[Class Certification 03142018]/[Pleadings]/231-10.pdf
481.	[Class Certification 03142018]/[Pleadings]/231-100.pdf
482.	[Class Certification 03142018]/[Pleadings]/231-101.pdf
483.	[Class Certification 03142018]/[Pleadings]/231-102.pdf
484.	[Class Certification 03142018]/[Pleadings]/231-103.pdf
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487.	[Class Certification 03142018]/[Pleadings]/231-106.pdf
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489.	[Class Certification 03142018]/[Pleadings]/231-108.pdf
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492.	[Class Certification 03142018]/[Pleadings]/231-110.pdf
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494.	[Class Certification 03142018]/[Pleadings]/231-112.pdf
495.	[Class Certification 03142018]/[Pleadings]/231-113.pdf
496.	[Class Certification 03142018]/[Pleadings]/231-12.pdf
497.	[Class Certification 03142018]/[Pleadings]/231-13.pdf
498.	[Class Certification 03142018]/[Pleadings]/231-14.pdf
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500.	[Class Certification 03142018]/[Pleadings]/231-16.pdf
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502.	[Class Certification 03142018]/[Pleadings]/231-18.pdf
503.	[Class Certification 03142018]/[Pleadings]/231-19.pdf
504.	[Class Certification 03142018]/[Pleadings]/231-2.pdf

505.	[Class Certification 03142018]/[Pleadings]/231-20.pdf
506.	[Class Certification 03142018]/[Pleadings]/231-21.pdf
507.	[Class Certification 03142018]/[Pleadings]/231-22.pdf
508.	[Class Certification 03142018]/[Pleadings]/231-23.pdf
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510.	[Class Certification 03142018]/[Pleadings]/231-25.pdf
511.	[Class Certification 03142018]/[Pleadings]/231-26.pdf
512.	[Class Certification 03142018]/[Pleadings]/231-27.pdf
513.	[Class Certification 03142018]/[Pleadings]/231-28.pdf
514.	[Class Certification 03142018]/[Pleadings]/231-29.pdf
515.	[Class Certification 03142018]/[Pleadings]/231-3.pdf
516.	[Class Certification 03142018]/[Pleadings]/231-30.pdf
517.	[Class Certification 03142018]/[Pleadings]/231-31.pdf
518.	[Class Certification 03142018]/[Pleadings]/231-32.pdf
519.	[Class Certification 03142018]/[Pleadings]/231-33.pdf
520.	[Class Certification 03142018]/[Pleadings]/231-34.pdf
521.	[Class Certification 03142018]/[Pleadings]/231-35.pdf
522.	[Class Certification 03142018]/[Pleadings]/231-36.pdf
523.	[Class Certification 03142018]/[Pleadings]/231-37.pdf
524.	[Class Certification 03142018]/[Pleadings]/231-38.pdf
525.	[Class Certification 03142018]/[Pleadings]/231-39.pdf
526.	[Class Certification 03142018]/[Pleadings]/231-4.pdf
527.	[Class Certification 03142018]/[Pleadings]/231-40.pdf
528.	[Class Certification 03142018]/[Pleadings]/231-41.pdf
529.	[Class Certification 03142018]/[Pleadings]/231-42.pdf
530.	[Class Certification 03142018]/[Pleadings]/231-43.pdf
531.	[Class Certification 03142018]/[Pleadings]/231-44.pdf
532.	[Class Certification 03142018]/[Pleadings]/231-45.pdf
533.	[Class Certification 03142018]/[Pleadings]/231-46.pdf
534.	[Class Certification 03142018]/[Pleadings]/231-47.pdf
535.	[Class Certification 03142018]/[Pleadings]/231-48.pdf
536.	[Class Certification 03142018]/[Pleadings]/231-49.pdf
537.	[Class Certification 03142018]/[Pleadings]/231-5.pdf
538.	[Class Certification 03142018]/[Pleadings]/231-50.pdf

539.	[Class Certification 03142018]/[Pleadings]/231-51.pdf
540.	[Class Certification 03142018]/[Pleadings]/231-52.pdf
541.	[Class Certification 03142018]/[Pleadings]/231-53.pdf
542.	[Class Certification 03142018]/[Pleadings]/231-54.pdf
543.	[Class Certification 03142018]/[Pleadings]/231-55.pdf
544.	[Class Certification 03142018]/[Pleadings]/231-56.pdf
545.	[Class Certification 03142018]/[Pleadings]/231-57.pdf
546.	[Class Certification 03142018]/[Pleadings]/231-58.pdf
547.	[Class Certification 03142018]/[Pleadings]/231-59.pdf
548.	[Class Certification 03142018]/[Pleadings]/231-6.pdf
549.	[Class Certification 03142018]/[Pleadings]/231-60.pdf
550.	[Class Certification 03142018]/[Pleadings]/231-61.pdf
551.	[Class Certification 03142018]/[Pleadings]/231-62.pdf
552.	[Class Certification 03142018]/[Pleadings]/231-63.pdf
553.	[Class Certification 03142018]/[Pleadings]/231-64.pdf
554.	[Class Certification 03142018]/[Pleadings]/231-65.pdf
555.	[Class Certification 03142018]/[Pleadings]/231-66.pdf
556.	[Class Certification 03142018]/[Pleadings]/231-67.pdf
557.	[Class Certification 03142018]/[Pleadings]/231-68.pdf
558.	[Class Certification 03142018]/[Pleadings]/231-69.pdf
559.	[Class Certification 03142018]/[Pleadings]/231-7.pdf
560.	[Class Certification 03142018]/[Pleadings]/231-70.pdf
561.	[Class Certification 03142018]/[Pleadings]/231-71.pdf
562.	[Class Certification 03142018]/[Pleadings]/231-72.pdf
563.	[Class Certification 03142018]/[Pleadings]/231-73.pdf
564.	[Class Certification 03142018]/[Pleadings]/231-74.pdf
565.	[Class Certification 03142018]/[Pleadings]/231-75.pdf
566.	[Class Certification 03142018]/[Pleadings]/231-76.pdf
567.	[Class Certification 03142018]/[Pleadings]/231-77.pdf
568.	[Class Certification 03142018]/[Pleadings]/231-78.pdf
569.	[Class Certification 03142018]/[Pleadings]/231-79.pdf
570.	[Class Certification 03142018]/[Pleadings]/231-8.pdf
571.	[Class Certification 03142018]/[Pleadings]/231-80.pdf
572.	[Class Certification 03142018]/[Pleadings]/231-81.pdf

573.	[Class Certification 03142018]/[Pleadings]/231-82.pdf
574.	[Class Certification 03142018]/[Pleadings]/231-83.pdf
575.	[Class Certification 03142018]/[Pleadings]/231-84.pdf
576.	[Class Certification 03142018]/[Pleadings]/231-85.pdf
577.	[Class Certification 03142018]/[Pleadings]/231-86.pdf
578.	[Class Certification 03142018]/[Pleadings]/231-87.pdf
579.	[Class Certification 03142018]/[Pleadings]/231-88.pdf
580.	[Class Certification 03142018]/[Pleadings]/231-89.pdf
581.	[Class Certification 03142018]/[Pleadings]/231-9.pdf
582.	[Class Certification 03142018]/[Pleadings]/231-90.pdf
583.	[Class Certification 03142018]/[Pleadings]/231-91.pdf
584.	[Class Certification 03142018]/[Pleadings]/231-92.pdf
585.	[Class Certification 03142018]/[Pleadings]/231-93.pdf
586.	[Class Certification 03142018]/[Pleadings]/231-94.pdf
587.	[Class Certification 03142018]/[Pleadings]/231-95.pdf
588.	[Class Certification 03142018]/[Pleadings]/231-96.pdf
589.	[Class Certification 03142018]/[Pleadings]/231-97.pdf
590.	[Class Certification 03142018]/[Pleadings]/231-98.pdf
591.	[Class Certification 03142018]/[Pleadings]/231-99.pdf
592.	[Class Certification 03142018]/[Pleadings]/232 Memo.pdf
593.	[Guha Deposition]/Exhibit 1.pdf
594.	[Guha Deposition]/Exhibit 2.pdf
595.	[Guha Deposition]/Exhibit 3.pdf
596..	[Guha Deposition]/RAHUL K. GUHA, PH.D., ct.pdf
597.	[Guha Deposition]/RAHUL K. GUHA, PH.D., full.pdf
598.	[Ricchetti Deposition]/BRYAN RICCHETTI, PH.D., ct.pdf
599.	[Ricchetti Deposition]/BRYAN RICCHETTI, PH.D., full.pdf
600.	[Ricchetti Deposition]/Ricchetti 001.pdf
601.	[Ricchetti Deposition]/Ricchetti 002.pdf
602.	[Ricchetti Deposition]/Ricchetti 003.pdf
603.	[Ricchetti Deposition]/Ricchetti 004.pdf
604.	[Ricchetti Deposition]/Ricchetti 005.pdf
605.	[Ricchetti Deposition]/Ricchetti 006.pdf
606.	[Ricchetti Deposition]/Ricchetti 007.pdf

607.	[Ricchetti Deposition]/Ricchetti 008.pdf
608.	[Ricchetti Deposition]/Ricchetti 009.pdf
609.	[Ricchetti Deposition]/Ricchetti 010.pdf
610.	[Ricchetti Deposition]/Ricchetti 011.pdf
611.	[Ricchetti Deposition]/Ricchetti 012.pdf
612.	Agency Codes for Other Arrests in 2012-2017.csv
613.	Arrests 2012-2017 (Other Agencies Only).csv
614.	Complaint Searchable.pdf
615.	FY16 MOHS Grant Application.docx
616.	Jail Docket 2012-2017 (MCSO ARRESTS ONLY).CSV
617.	Madison County Justice Court Citations 2012-2017.xlsx
618.	Master CAD Report.csv
619.	Roadblock Locations from 1.1.12 through 8.24.17.csv
620.	US v Johnson II.pdf
621.	12-21-17 - Brown - Tucker - Compressed.pdf
622.	12-21-17 - Brown - Williams - Compressed.pdf
623.	12-21-17 - Brown - Sandridge - Compressed.pdf
624.	12-21-17 - Brown - Thompson - Compressed.pdf
625.	Declaration of Mark Sandridge
626.	2018 05 02 Letter to Defs. with Enclosure.pdf
627.	Letter to Kavitha Sivashanker 04252018.pdf

Exhibit C: Signed Declaration

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
NORTHERN DIVISION

LATOYA BROWN, et al.

PLAINTIFFS

v.

CIVIL ACTION NO. 3:17-cv-347 WHB LRA

MADISON COUNTY, MISSISSIPPI; et al.

DEFENDANTS

DECLARATION OF DWIGHT STEWARD

I, Dwight Steward, make the following declaration based on personal knowledge:

1. I have been retained by the Defendants in the above referenced matter as expert. I submit that the foregoing Rebuttal Report Regarding Dr. Bryan Ricchetti from May 8, 2018 is a true and accurate copy of the report I provided to Defendants in this matter. I declare that the information and opinions contained in the report are true and correct to the best of my knowledge.

I declare under penalty of perjury that the foregoing is true and correct. 28 U.S.C. § 1746.

May 8, 2018


DWIGHT STEWARD

EXHIBIT 6

**IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
NORTHERN DIVISION**

LATOYA BROWN, et al.,)	PLAINTIFFS
)	
vs.)	Civ. No. 3:17-cv-347 WHB LRA
)	
MADISON COUNTY,)	DEFENDANTS
MISSISSIPPI, et al.,)	
)	
_____)	

REPORT OF WILLIAM R. FUNDERBURK

May 8, 2018

1. QUALIFICATIONS

1. I am a Field Applications Scientist with the University of Southern Mississippi's Gulf Coast Geospatial Center (GCGC) as well as adjunct faculty member for the Division of Marine Science's Department of Hydrography. I have been employed with USM GCGC since 2013. I have a B.S. in Geography (2012) and M.S. in Geography (2014), both from USM's Department of Geography and Geology in 2012 and 2014. I also have a minor in Mathematics.

2. I have been adjunct faculty with the Department of Hydrography since 2016 where I have been responsible for developing and teaching two courses for the Department's undergraduate program: 3D positioning and Remote Sensing. As one of the only undergraduate hydrographic surveying programs in the country, and one of two programs nationally, all graduate and undergraduate courses in this renowned program are taught to International Hydrography Organizations (IHO) category A or B, surveying standards.

3. Designated by NOAA in 2007 as the Mississippi Spatial Reference Center (MSRC), GCGC is partly responsible for ensuring that accurate geopositional information is collected, distributed, maintained and included in the National Spatial Reference System (NSRS). We are also tasked with creating useful and comprehensive geographic information systems (GIS) datasets using new and existing geodetic, remote sensing, terrestrial gravity and other physical geographic information and research.

4. The GCGC established, maintains and operates a statewide network of 52 continuously operating reference stations (CORS) in Mississippi. The network is real – time capable providing the most accurate and precise Global Positioning Systems (GPS) solutions and serves approximately 1,000 institutional users throughout the state as well as provides direct support for Mississippi's Department of Transportation (MDOT).

5. In 2013 the GCGC became the lead institution for NOAA's gulf-wide Regional Geospatial Modeling Program, which is a five-year five-state comprehensive program to combine and expand on the National Spatial Reference System assets in the Gulf of Mexico Region. GCGC serves as lead to several subsidiary entities: Texas A&M University Corpus Christi's Texas Spatial Reference Center (TSRC), Louisiana State University's (Louisiana Spatial Reference Center), The State of Alabama's Department of Transportation and the University of Florida.

6. The position of field applications scientist serves as a research and applications geoscientist for the GCGC. The purpose of this position is to research, develop, and implement innovative field and mathematical/computer-based capabilities for environmental modeling. This position am also responsible for cultivating external relationships and engaging in both internally and externally led collaborative scientific research efforts as a role of lead or participant.

7. In my work with USM's GCGC as a field applications scientist I have developed an expertise in high-accuracy, high precision Geospatial and Geographic analyses. Specifically, my

expertise is in the development and of high accuracy, high precision GPS experiments, and novel applications of GPS in augmented environmental biophysical modeling.

8. I have been employed through competitive regional geospatial modeling research grants since I began my career at the University of Southern Mississippi in 2013. A list of other significant research projects as well as respective grant numbers, conference presentations, and publications can be found in my CV, which is attached to this report as **APPENDIX A**.

9. I have not testified as an expert at trial or by depositions in the last four years. I have co-authored 3 peer-reviewed scientific publications in the last four years with another currently in revision. I am being compensated at a rate of \$150/hour for my services.

2. ASSIGNMENT AND SUMMARY OF FINDINGS

2.1 Assignment

10. I have been asked by Wise Carter Child & Caraway, P.A., to serve as a subject matter expert in, geography and geographic analysis using the geographic information systems (GIS) software, ArcGIS.

11. My specific objectives were 1) investigate information about geocoded roadblock locations; 2) evaluate the ability to conduct comprehensive geographic analysis for roadblocks in Madison County; 3) to review and evaluate methodology used by Dr. Ricchetti and the team at Cornerstone in their geographic analysis and geocoding and 4) to provide technical assistance generally on GIS issues.

12. As part of my work, I reviewed all the documents listed in **APPENDIX B**. I reviewed Dr. Ricchetti's report, deposition, and production datasets containing his geographic analysis. Additionally, I interviewed Deputy Rylon Thompson as part of my ground truth validation of roadblock locations.

2.2 Summary of Findings

13. There is very little mention of geographical methods used in Dr. Ricchetti's report. In fact, his explanation is limited to the contents of footnote 14 of his report. This completely glosses over the complex issues related to geocoding MCSD roadblock locations and assigning them to census tracts.

14. Most of the roadblocks addresses only provide intersection information, while a very small number contain street-numbered addresses similar to postal addresses. The intersection-only addresses are inadequate to allow the precise or accurate geocoding for anything beyond the software programs estimated center of the roadways. As a geographer, I would believe this to be the location where the centerlines of the two intersecting streets cross.

15. Based on my experience, you would not be able to accurately geocode roadblocks near an intersection or an approaching street with intersection-only address information. For example, you would need to know the location's orientation from the center point of the intersection and how many feet out from the intersection the roadblock occurred from the center of the intersection.

16. Dr. Ricchetti's census-tract assignments are completely unreliable and unhelpful regarding the location of roadblocks. There are countless erroneously geocoded locations and/or incorrect assignments to census tracts. Likewise, his assignments fail to account for the fact that more than 662 of the 2,004 roadblocks locations he straddle two more census tracts, which his analysis failed to account for.

17. Dr. Ricchetti's address "cleaning process" and quality assurance technique involving a "match score" of "90 or better" did nothing to improve the reliability of his data or methods. It actually injects more error into the overall analysis.

18. It is my opinion no geographer would be able to reliably, accurately, or precisely geocode the specific roadblock locations using only the name of nearby intersecting streets. This opinion is based upon my experience and my review of the documentation and data described.

19. Based on the materials I have reviewed, Dr. Ricchetti did not conduct any generally accepted procedures in geocoding roadblock locations. Further, it is obvious that he did not perform any accuracy assessment on their geocoded locations.

3. METHODOLOGY AND DATA

20. In this section, I explain Dr. Ricchetti's methodology and my methodology for conducting a geographic analysis of Dr. Ricchetti's data. I also provide an overview of geocoding.

3.1 Dr. Ricchetti's Geographic Analysis

21. Dr. Ricchetti's report provides very little information on his geographical analysis. In fact, the only explanation is in footnote 14, which provides "I convert the addresses into longitude and latitude coordinates. Only roadblocks for which an accurate set of coordinates can be determined are used in my analysis. This removes 14.9% of the roadblocks listed in the three data sources for my analysis."

22. His report makes no mention of any tool or methodology he used to explain how he converted intersection-only addresses to geographic coordinates. He simply used the term "geocode" to identify he converted addresses. This explanation glosses over the complex processes related to accurately and reliably geocoding roadblock locations. That process was made even more difficult here since a large majority of MCSD roadblock locations are identified only by nearby intersections, not postal addresses.

23. From reviewing Dr. Ricchetti's deposition, I found that he was unable to explain the process that he used to convert intersection names to geographic coordinates of roadblock locations.

24. Despite the very limited information I attempt to explain Dr. Ricchetti's (or whoever did it for him) methodology for geocoding roadblock locations and assigning them to census tracts in Madison County.

25. Dr. Ricchetti identified three sources of roadblock information in footnote 23: data from the CAD file (1,697 roadblocks), data from handwritten notes by MCSD's DUI personnel (161 roadblocks), and data gathered from Plaintiffs' counsels' review of individual incident reports (146 roadblocks). He combined these sources into a single dataset.

26. Using a program called ArcGIS, someone conducted a geographic analysis on his behalf and based on this analysis assigned the geocoded roadblock locations to census tracts. As discussed below, I am very familiar with ArcGIS.¹

27. It appears that someone took the "original addresses" from this dataset and processed them into "cleaned address." There is no information on how this task was performed or what rules, if any, were used to ensure reliability.

28. Many of these original roadblock addresses did not include street numbers and, thus, were not addresses in the common sense of the term. Many original addresses only provided the names of the nearby intersecting streets. As discussed below, whatever process they used, it did not resolve the ambiguity of geocoding point data from intersection information.

29. Dr. Ricchetti's production file indicates that the "cleaned" address information was entered into ArcGIS. ArcGIS then converted this address information into longitude and latitude coordinates. The process for converting addresses into geographic coordinates is commonly referred to as "geocoding."²

30. The precision, accuracy, and reliability of geocoding are determined by the amount of specific geographic or location information available. For example, if the only specific geographic information entered into ArcGIS is "East Capitol Street, Jackson, Mississippi" ArcGIS will locate "East Capitol Street", but will be unable to accurately identify where on East Capitol Street something is located without more specific information. If the location is identified as "East Capitol / Congress Street, Jackson, Mississippi," ArcGIS will estimate that it is in the middle of that intersection.

31. Each geocoded position from Dr. Ricchetti's work represents ArcGIS's interpretation of where a MCSD conducted a roadblock or checkpoint based on the cleaned addresses

32. Dr. Ricchetti said that he reviewed ArcGIS's "match score" to evaluate the newly-geocoded locations. He said he eliminated all locations that did not have a "match score" of 90 or higher. As discussed below in Part 4, this "match score" does not ensure accuracy and reliability, despite its name. Here, I believe his methods might have actually injected more error into the data.

¹ Dr. Ricchetti admitted during his deposition that he did not do the geocoding. (Tr. 163:6). He also admitted that no one on the team working under him was a geographer. (Tr. 196:13).

² ArcGIS defines geocoding as "the process of assigning a location, usually in the form of coordinate values, to an address." See *ArcGIS v10.5 Tool Description*.

33. The “match score” is the only quality control standard referenced by Dr. Ricchetti. However, “match score” does not distill the data down to what Dr. Ricchetti described in his deposition.

34. The Census Bureau divides the country into different-sized subdivisions for its counts and estimates. Census tracts are small, relatively permanent statistical subdivisions of a county or equivalent entity that are updated infrequently, but just prior to each decennial census.³ Census tracts generally have a population size between 1,200 and 8,000 people, with an optimum size of 4,000 people. Census tract boundaries generally follow visible and identifiable features, typically roads.

35. Dr. Ricchetti “assigned” the remaining geocoded location to one of Madison County’s 21 census tracts. There was no explanation as to how this was done by Dr. Ricchetti. When joining datasets together in ArcGIS, there are specific types of joins that can be performed depending upon the type of data and attributes associated with it. This is especially important here where you have different layers of data.

36. Using these “assignments”, he then totaled up the all the roadblocks from 2012 – 2017 in each of Madison County’s 21 census tracts. Based on the totals from this assignment, he conducted various analyses.

3.2 My Review of Geocoded Roadblock Information

37. I reviewed Dr. Ricchetti’s report and deposition to learn more about the process for cleaning addresses and geocoding. I also reviewed data sets provided in Dr. Ricchetti’s production file.

38. I also reviewed a composite list of two of Dr. Ricchetti’s datasets, which are referred to as “Compiled Unique Roadblocks.” This list includes 1,697 CAD roadblocks and 146 Additional Roadblocks, totaling 1,843 roadblocks from 2012 through 2017. Based on Dr. Ricchetti’s report, these roadblocks were at 361 unique locations in Madison County. These roadblocks are sorted by frequency and listed in **APPENDIX D** and are referred to as “Compiled Unique Roadblocks.” This list does not include the 161 handwritten roadblocks used by Dr. Ricchetti and referenced in footnote 23 of his report.

39. Dr. Ricchetti’s production file contained several datasets with pre and post geocoded address information. For example, a folder located in his production file “Expert Report Production File→Data→Input→Roadblock Data” had several datasets contained in subfolders with “raw,” “cleaned,” “unique_addresses,” and “geocoding_output.” I reviewed these files in Arc GIS v.10.5 to plot the positions by their longitude and latitude coordinates (i.e., their X and Y coordinate attribute fields).

40. ArcGIS software program is used for surveying, socio-economics, and heavy processing of remotely sensed datasets such as Lidar, Sonar, Radar and multispectral image datasets. Geographers and hydrographers use ArcGIS all the time.

³ “Geographic Terms and Concepts,” U.S. Census Bureau available at <https://goo.gl/k98EMy>.

41. While ArcGIS is a very robust software and has lots of capabilities, it is very complicated and requires a technical understanding of what the software will do (or is doing) when performing one of its many functions. Geographers and hydrographers are formally trained on the software throughout their education. We teach classes on it and it is virtually part of every analysis we do.

42. Using ArcGIS, I reviewed Dr. Ricchetti's findings and attempted to verify some of the geocoded locations using ground truth.

4. GEOGRAPHIC ANALYSIS

43. Again, there was very little information regarding Dr. Ricchetti's process, tools, or software used in geocoding as well as his methods for deriving geographic coordinates of roadblock locations. Also, there was no mention of data standards or GIS pre-processing/calibration techniques performed, such as defining datum, coordinate system and projection, performed to ensure quality assurance of resultant output.

4.1 Ability to Geocode Roadblocks Using Only Nearby Intersection Information

44. Most roadblocks addresses maintained by the MCSD only include an intersection address. This is true for address information found the datasets, including the addresses in the Compiled Unique Addresses.

45. As I mentioned above, the Compiled Unique Roadblocks dataset contained 361 locations. Only 24 out of the 361 locations contain a street numbered address. Thus, from this sample, I estimate that 93.4% of the roadblock locations were identified by intersection-only information.

46. I interviewed Deputy Rylon Thompson for my purposes of my review. Based on my discussion with Deputy Thompson, it does not appear that the address information kept by MCSD contains enough information to perform geographic analysis such as geocoding.

47. This led to numerous geocoding errors, in turn, affecting the "assignment" of roadblocks to census tracts. These errors are best illustrated by reviewing the Compiled Unique Roadblocks that was compiled from Dr. Ricchetti's production file, **APPENDIX D**.

48. What follows is an incomplete list of geocoding and census tract assignment errors that I have identified in my review and discussions. The exhibits referenced below are attached to my report:

- a. Exhibit 1 shows several roadblock locations near the Reservoir. None of the mapped locations show where MCSD conducts roadblocks. Point No. 18 should be 0.21 miles north on Harbor Drive, while Point No. 159 should be south on Harbor Drive. Both should be in the same location. MCSD does not conduct roadblocks on Breakers Lane, which is, apparently, which is what Point No. 287 depicts. Point No. 287 on Dr. Ricchetti's addresses is identified as "BREAKERS LN, MADISON COUNTY, MS." As a geographer, this appears to be a location plotted at a random spot the street based on a guess by ArcGIS.

- b. Exhibit 2 shows the area near that depicted in Exhibit 1, but further south on Spillway Road. Point Nos. 3 and 53 should be marked about a ½ mile further south on Spillway Road. A blue “x” shows where these locations should generally be. MCSD set its roadblocks much further south on Spillway Road to make its roadblocks more effective. Regardless, Point No. 3, which has 65 roadblocks, is assigned to Census Tract No. 301.07. Point No. 53, which had 8 roadblocks during the time period, is assigned to Census Tract No. 301.08. This does not make sense to me and suggests there is no coherent and reliable methodology for assigning roadblocks that straddle tract boundaries. These two roadblocks are at the same locations but assigned to two different census tracts by Dr. Ricchetti.
- c. Exhibit 3 shows roadblock locations Nos. 141 and 215 that are both plotted on US Highway 51 near the Natchez Trace. Both of these locations are incorrectly shown to be in the middle of HWY 51. The actual physical location should be moved to near the information cabin on the Natchez Trace. The proper location for these roadblocks has been marked with a blue “x” on Exhibit 3.
- d. Exhibit 4 shows roadblock locations on Highway 43 and near an entrance and exit ramp for the Natchez Trace. This exhibit shows Dr. Ricchetti’s geocoded locations Nos. 14 and 203. Both of those locations are plotted in the wrong spot. The proper location for these roadblocks are shown with a blue “x.” Roadblocks at this location actually cover two areas at this location, which are marked.
- e. Exhibit 5 shows geocoded locations nos. 344 and 51, which are both on Yandell Road. Though both show they are on Yandell Road, they are assigned to two different census tracts. No. 344 is assigned to census tract 309. No. 51 is assigned to census tract 302.01.
- f. Exhibit 6 shows numerous roadblocks on or near Yandell Road, all at the wrong location. Point Nos. 98, 100, 129, 151, 161, and 193 should be located in front of Madison Crossing Elementary School. Using Dr. Ricchetti’s locations, these locations range from .15 miles to .48 miles off the actual location. The proper location for these roadblocks has been marked with a blue “x.”
- g. Exhibit 7 depicts a geocoded roadblock location slightly north of Canton, MS. This roadblock location is usually set up in the actual intersection, but the geocoding does not reflect the actual location. Here, Dr. Ricchetti’s coordinates do not even show that we are in the actual middle of the intersection when a roadblock is actually there. Point No. 11 has 32 road blocks allocated to it according to the Compiled Unique Roadblocks. This roadblock straddles census tract 304, which is predominantly White, and census tract 305, which is predominantly Black. All of No. 11’s 32 roadblocks are assigned to census tract 305.
- h. Exhibit 8 shows point no 77. In reviewing these I see that this has a cleaned address as “LAKE HARBOR DRIVE AND RANKIN, MADISON COUNTY, MS.” According to the MCSD, the text of the location information from the records

indicates this location is near the Reservoir, which is shown on Exhibit Nos. 1 and 2, above. If so, this location should be well to the east of the geocoded coordinates used by Dr. Ricchetti. According to MCSD, Point No. 77, as geocoded, shows this location directly behind North Park Mall, which is a couple of miles from the actual location, near Rankin County. This would be near the Reservoir on Lake Harbor near lower Spillway Road as reflected in Exhibit No 2.

- i. Exhibit 9 (Figure 1) shows point No. 244 and the text of the address information from our records. The “clean address” shows the location as “OLD CANTON ROAD AND MRA, MADISON COUNTY, MS.” This location should be located where there is a blue “x”. This location is approximately 2.35 miles north of the actual physical location, as described in the address. Based on Dr. Ricchetti’s coordinates, this roadblock location is in the city of Ridgeland. This implies that MRA, which I understand is a local private school near point No. 188, is located in the City of Ridgeland, not the City of Madison, where I understand it is actually located.

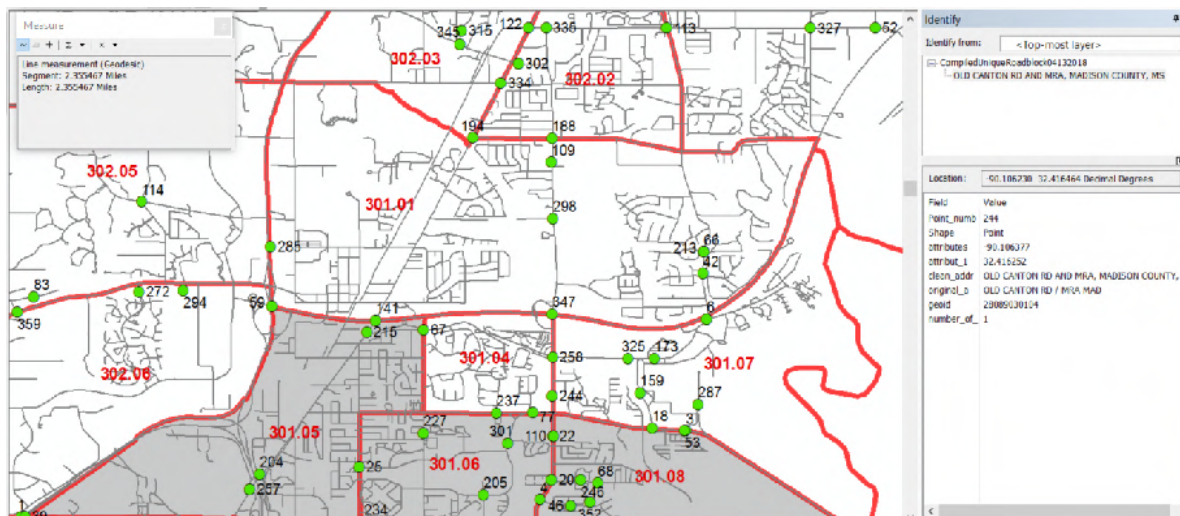


Figure 1: Screen shot depicting 2.35 mile error from point no. 244 and MRA actually existing near point 188.

- j. Exhibit 10 shows the inherent topological error that comes with geocoding. As discussed elsewhere in this Report, this why it is critical to define your datum, your coordinate system, and project your data before conducting any geographic or geospatial analysis. This exhibit shows the inherent error that will be propagated through the entire analysis. As discussed below, the error in Dr. Ricchetti’s analysis may little as 3-10 meters, 50-100 meters, or 2.35 miles, as shown in Exhibit 9.
 - k. Exhibit 11 shows point No. 12. Per Dr. Ricchetti’s geocoded coordinates, this roadblock is located in the middle of a local wildlife refuge on a dead-end road. It has been noted on Ex 11 where the roadblock actually would be on Highway 43.
49. To geocode properly, the software needs to compute the geometry of the desired point information. If we are using hard street addresses and have performed our pre-processing

calibration, it is a relatively easy process. However, using intersection-only information introduces a variety of errors in geospatial accuracy and precision.

50. Dr. Ricchetti simply assumed that the intersection address was the proper physical address and that all the roadblocks were actually located in middle of the described intersections. (Tr. 183:7-9).

4.2 Roadblocks That Straddle Census Tracts.

51. As Dr. Ricchetti explains, he attempted to geocode roadblock locations and assign each to one of Madison County's census tracts. This poses a unique problem, as he recognized during his deposition. (Tr.178:4). Roadblocks and census tract boundaries by their very nature both occur in the middle of roads.

52. It is clear that Dr. Ricchetti's methodology did not account for this reality. Instead, in instances where a roadblock straddled two census tracts, he simply deferred to ArcGIS to assign the straddling roadblock to one of two census tracts. From his deposition, he it appears he did not recognize this until it was brought to his attention. As a geographer, I would have had to address this early on in my process.

53. Dr. Ricchetti made no effort to account for straddling roadblocks, deferring to ArcGIS to decide which census tract to assign roadblocks. Since some straddling roadblocks had numerous roadblocks at that location from 2012 through 2017, the misleading information can have profound impacts on the number of roadblocks per census tract and is not a valid representation of what actually occurred.

54. As geographer and professional in the geospatial industry, if I run into issues such as a geocoded location that straddles two or more census tracts, I develop a transparent, reliable, and repeatable methodology, perform ground truth validations on a subset of data points, and assign rules for geocoded locations that occur over two or more census tract boundaries to ensure accuracy and precision.

55. Not only did Dr. Ricchetti testify at his deposition that he did not perform this verification, he testified that he needed to do it following the deposition so he could determine the reliability of his data and his analysis. This data is the data that he already has used in his regression analysis.

56. My finding regarding straddling roadblocks assumes that Dr. Ricchetti could accurately and precisely geocode roadblock locations using intersection address information, which he could not, and shows that he still did not properly assign roadblocks to census tracts.

57. My review of the Compiled Unique Roadblock locations found that 82 of the 361 geocoded locations straddled two or more census tract. Because there were multiple roadblocks at several of these locations, these 82 locations account for 662 of the 1,843 roadblocks in the Compiled Unique Roadblock set. These locations are shown on **Figure 2**, below.

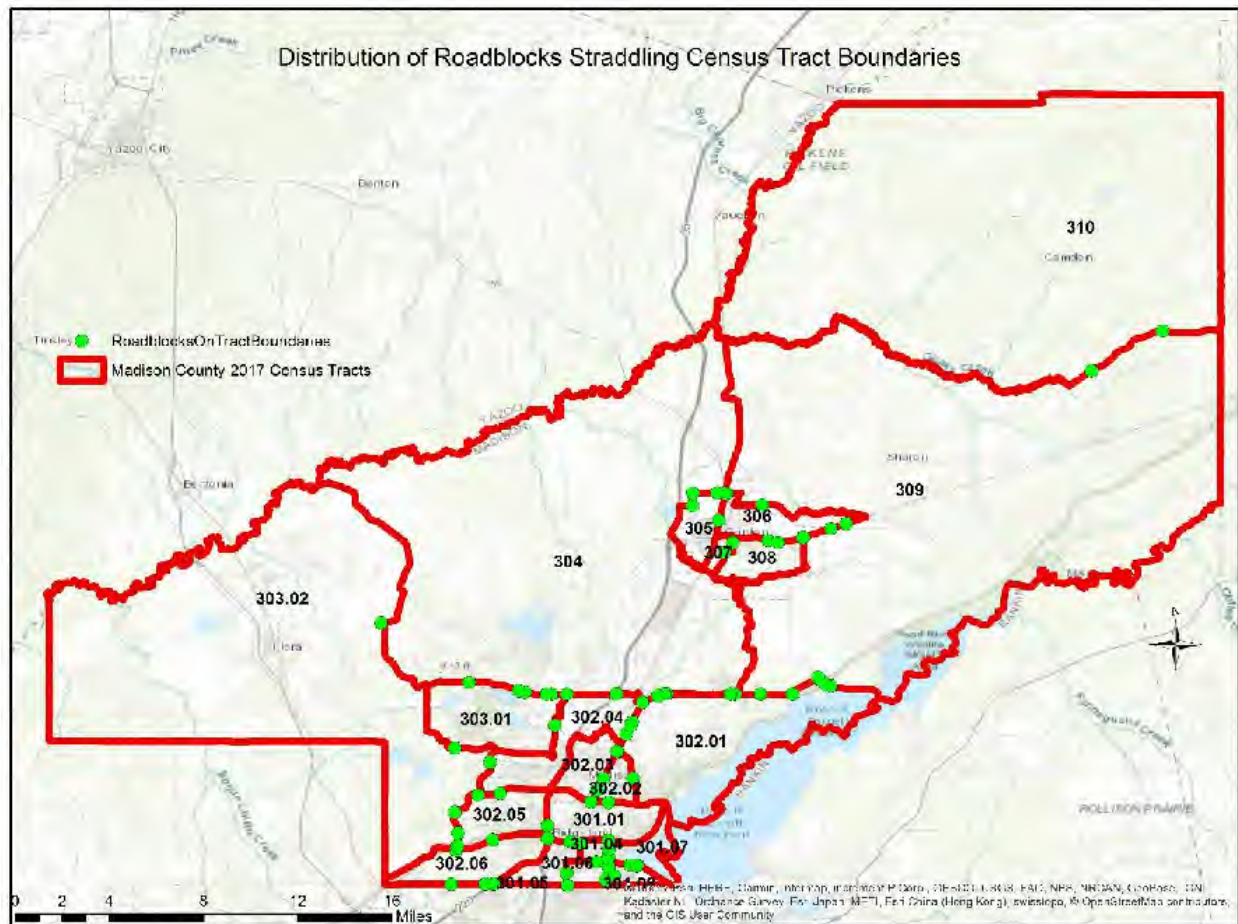


Figure 2: This map depicts the distribution of geocoded roadblocks from the *Compiled Unique Roadblocks* that fell on census tract boundaries.

58. Approximately 23% of 361 roadblock locations straddle census tracts. Considering that several locations had multiple roadblocks located there from 2012 to 2017, 36% of 1,843 total roadblocks straddle two or more census tracts. From an analysis standpoint, that is a tremendous amount of data that should be rendered invalid.

59. Again, this finding is based on the assumption that his geocoding was done correctly, accurately, and precisely, which it was not.

4.3 Verification and Dr. Ricchetti's Match-Score Cutoff

60. Dr. Ricchetti testified that he did not actually perform any validation of his geocoded locations (Tr. 172:22; 173:16-23; 174:18; and 196:1). Instead, he relied on a “match score” produced by ArcGIS to rate locations. (Tr. 168:12). He claimed that if that score fell below a 90% it was excluded from his analysis. (Tr. 168:9; 177:18-22).

61. Following Geocoding, ArcGIS evaluates and scores whether the original address information “matches” the known address information for the newly geocoded location. The scoring system does not provide any assurance that the geocoded location is accurate, but rather

compares and weighs the old address information against the new. This is especially unhelpful here because 93% of the addresses only contain street intersection information. Because the “match score” does not detract for missing information when comparing original and geocoded address information, geocoding less specific address information (i.e., addresses without street numbers) will actually increase the match score. Stated differently, the match scoring system will make something less specific sound more accurate.

62. I attempted to validate his process and plotted his geocoded addresses using his match-score of greater than or equal to 90 as a cutoff.

63. Because of the lack of information about Dr. Ricchetti’s process, it is difficult to verify his methods with respect to the three sets of roadblocks he analyzed, including ones he might have disregard even if they had a match score greater than or equal to 90.

64. We are, however, able to review his methodology using his actual geocoded data and actual “match scores” that he provided.

65. Below, **Figure 3** shows the plotted locations for “1_Geographic Coordinates For CAD Addresses.csv,” which is located in Dr. Ricchetti’s production folder. This shows all the locations *before applying* Dr. Ricchetti’s match score cutoff. These locations are plotted using Dr. Ricchetti’s actual coordinates.

65.1 This file is located in his production file at “Expert Report and Production File→ Data→ Input→ Roadblock Data→ 4_geocoding_output → “1_Geographic Coordinates For CAD Addresses.csv.” This file has 31,109 locations in it, which seems to be too excessive to be roadblock locations, though the folder structure suggests this is a list of roadblock locations. Regardless, this dataset contains geocoding information(X and Y coordinate) for those locations and along with match scores for each. Using this information, I am able to test Dr. Ricchetti’s match score of 90 or better match to show how meaningless it is.

66. This illustrates the problem with geocoding, especially of very large data sets that do not have reliable address information. You can see that the locations are plotted all over North America, including Washington State, New York State, San Diego, and Canada. Obviously, these coordinates are not reliable locations for areas within Madison County.

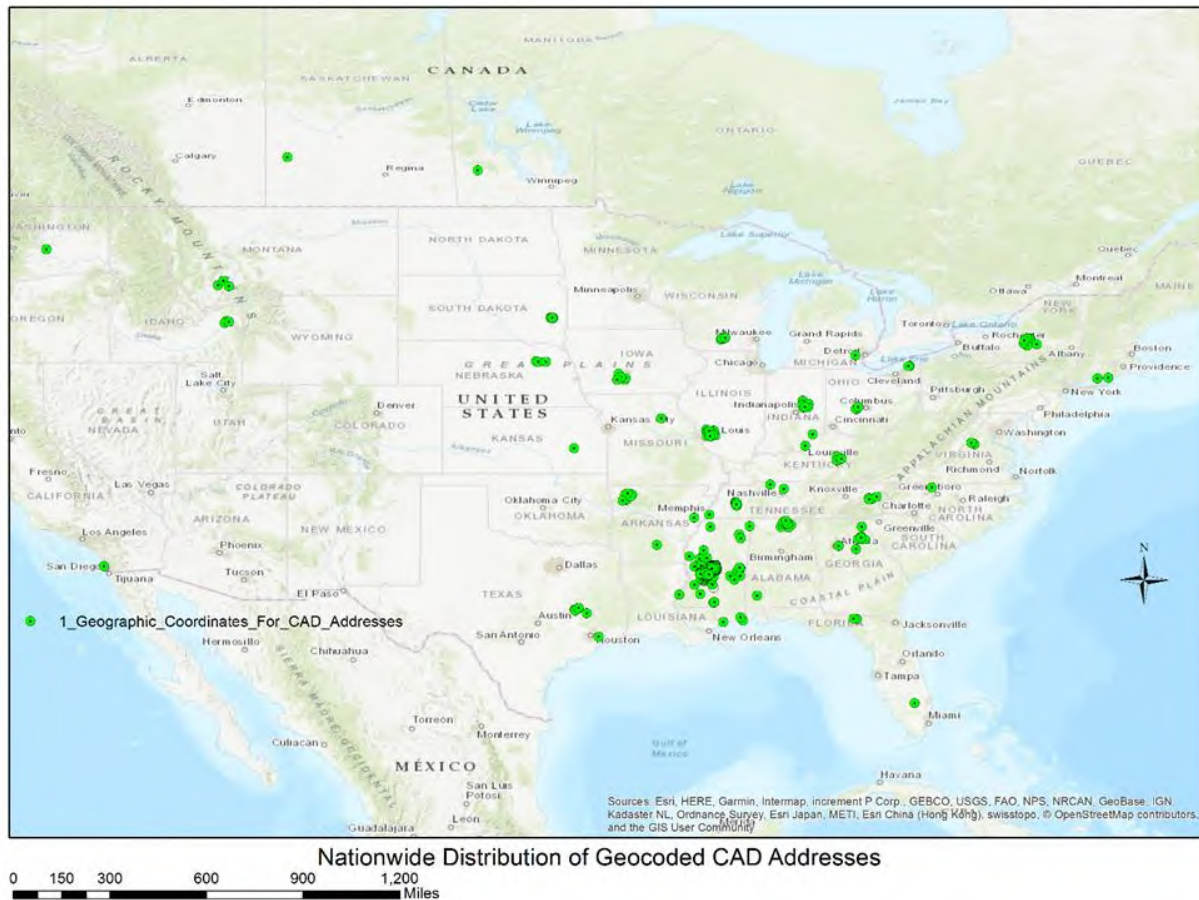


Figure 3: This map depicts the distribution of Dr. Ricchetti's Geocoded output addresses for the dataset "1_Geographic Coordinates For CAD Addresses.csv"

67. Next, I apply Dr. Ricchetti's match score of 90 or better to "improve" the locations in Madison County. According to Dr. Ricchetti, this assured better and more reliable locations. He testified that he only used locations with a match score of 90 or higher.⁴

68. As shown below in **Figure 4**, the "match score" cutoff does not provide the verification or accuracy that Dr. Ricchetti suggests. In fact, it raises serious concerns about his entire analysis since the match-score of 90 or better cutoff includes locations all over the continental United States. Certainly, geocoded locations in Wisconsin, Nebraska, Virginia, and Florida are not reliable locations for evaluating roadblocks in Madison County, Mississippi.

69. Dr. Ricchetti's report and testimony did not explain how he accounted for problematic locations that survived his match-score cutoff. Either these points were included in his analysis or he conducted some other secondary process to eliminate extreme errors. While it appears locations that show extreme error were not included in his roadblock locations, ignoring the extreme errors does not make the process or method reliable. Regardless, even throwing out the extreme errors, does not improve his data. Rather, it simply masks how unreliable its results were.

⁴ Applying Dr. Ricchetti's match-score quality assurance technique, reduced the amount of geocoded locations from 31,109 to 25,335. As shown, though, we still see a national distribution of geocoded address point. Again, this national distribution would give me serious concerns regarding the reliability of my geocoded information.

The error in his remaining data is neither acknowledged or accounted for. This error would propagate itself throughout the statistical analysis of this data too.



Figure 4: Distribution of geocoded addresses with a match score of greater than or equal to 90.

70. It does not surprise me to see the nation-wide distribution of 25,335 geocoded points, with a match score greater than or equal to 90. As I mentioned before, this is one of the major issues with improperly geocoding address and intersection information.

4.4 Coordinate Systems

71. There are numerous obvious technical issues that Dr. Ricchetti failed or was unable to explain in his report or deposition. Even more become apparent after reviewing his data sets. From the perspective of a geographer, these technical issues may me even greater concern with the reliability and accuracy of Dr. Ricchetti's methods.

72. Defining your reference frame is the first and arguably most crucial step in all geographical analyses. This information must be pushed to all datasets used or encompassed in the analyses or there will be topological issue. If the data sets in your analyses do not have the same defined reference frame information, the resultant output will contain inherent topological errors. For example, the points will not line up with other points, points will not line up with lines, and lines will not line up with other lines.

73. From reviewing Dr. Ricchetti's production file, it is unclear what coordinate system(s) he uses. His datasets seem to use several which inherently corrupt the reliability of his geocoding findings. As a geographer, using different coordinate systems on the same project is a cardinal sin.

74. My review of Dr. Ricchetti's data shows he used several. Based on my review of his information and the multiple coordinate systems he may have used, many, if not all, of his location may be off. Depending on the situation, some may be off anywhere from as little as 3-10 meters, 50-100 meters, or even greater than the 2.35 miles as previously shown in **Figure 1**.

75. To accurately and precisely geocode coordinates, we need to know or define the reference frame we are working within, the cardinal orientation from the centroid of the intersection, and radial distance measurements to the actual position the roadblock occurred with the center of the intersection.

76. After assigning coordinates, we would need to perform ground validation and accuracy assessment of coordinate information. This would need to be done prior to performing any spatial analyses or subsequent analysis.

77. Geocoding in its most basic form is like linear algebra. For example, you are simply plotting X and Y using geographic coordinate information.

78. If person A and person B are both working in Cartesian coordinate systems, with an origin of (0,0), person A and person B can plot the points (1,1) the same way with the same geometrical measurements. If plotted individually and compared, the points and distances should be comparable. This is an example of what would be considered accurate, precise, reliable and repeatable.

79. But GIS locations can be computed different ways using different coordinate systems. If the data are not uniform this will have major impacts on performing comparable geometrical computations. If, in my example, both A and B plot using geometrical computations, then their results would be comparable, but still accurate, precise, and reliable.

80. However, if A is working in the Cartesian coordinate system and B the Polar coordinate system, you have to perform complex conversions or transformations of their results in order to make A's and B's points line up. We would be working in two different geographic spaces defined by their respective coordinate systems.

81. Furthermore, even if we are working in the same coordinate system, if our origins are not comparable then the baseline data is not comparable to the repeat data. For example, person A has a (0,0) origin and person B has (-1, -1) origin; computing the geometry of point (1,1) will be inconsistent between the two investigators.

82. Projecting the data set (as well as aforementioned initial calibration steps) is crucial to computing geometry of address information and converting it to Latitude and Longitude coordinates.

83. Projecting your data set allows you to make linear measurements or linear geometric computations on a curved surface such as the earth.

84. I know of no generally-accepted method used by geographers that would allow for an accurate and precise geocoded location using the intersection-only information provided in the CAD report.

85. Based upon the information provided in his report and my review of the datasets in his production file, Dr. Ricchetti did not geocode properly.

86. Given he used invalid geographic layers and coinciding datasets to build his data, Dr. Ricchetti's statistical analysis would be unreliable and invalid.

87. Basic geocoding process is built around working within a defined reference frame, which Dr. Ricchetti failed to do. Defining your reference frame entails specifying horizontal and vertical datum(s), coordinate system(s), and projection(s). Only after this is determined and set up you can reliably calculate the geometry of the respective address information. None of this is defined in provided in Dr. Ricchetti's datasets. This assumes, of course, that you have actual address information and not just the name of an intersection.

4.5 Other Calibration and Technical Issues

88. There are inherent issues with accuracy and precision of coordinate information when using geocoding software to obtain coordinate information. It is best practice to validate computed location through ground verification observations. Dr. Ricchetti's report does not mention of any validation process of computed geocoded coordinates nor define any datum, coordinate or projection information.

89. Notably, Dr. Ricchetti's report contained no information on how he and his team went through the address "cleaning" process. Due to this fact, we can only speculate this was done objectively.

90. His report is riddled with ambiguities and uncertainties. This puts a heavy onus on the reader and investigator to speculate as to how he performed subsequent geographic (spatial) analysis.

91. In a defined reference frame and coordinates system, calculating the geometry for singular address is relatively easy to an expert, but calculating geometry of roadblocks from street address intersection information is completely different and comes with its own special set of issues (as with most things in GIS).

5. CONCLUSION

I conclude that the geographical analyses performed by Dr. Ricchetti are invalid. Given that the geographic analyses are the premise to the statistical argument, the statistical analyses is invalid as well.

May 8, 2018

/s/ William R Funderburk
William R. Funderburk

APPENDIX A

William R. Funderburk
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Education

Master of Science, Geography University of Southern Mississippi, Hattiesburg, MS	2014
Bachelor of Science, Geography University of Southern Mississippi, Long Beach, MS	2012
2 nd Bachelor of Science, Mathematics (projected completion) University of Southern Mississippi, Long Beach, MS	2018

Professional Work Experience

Field Applications Scientist, Gulf Coast Geospatial Center University of Southern Mississippi, Gulf Park Campus, Long Beach, MS	2017 - present
Research Associate, Gulf Coast Geospatial Center University of Southern Mississippi, Gulf Park Campus, Long Beach, MS	2015 – 2016
Graduate Research Assistant, Gulf Coast Geospatial Center University of Southern Mississippi, Stennis Space Center, MS	2013 – 2014
Teaching Assistant, Department of Geography and Geology University of Southern Mississippi, Hattiesburg, MS	Spring 2013
Field Tech, Department of Geography and Geology University of Southern Mississippi, Gulf Park Campus, Long Beach, MS	Dec. 2012 – Jan. 2013
Field Artillery (13B2P), United States Army Paratrooper Fort Bragg, North Carolina	Jan. 2003 – Jan. 2007

Publications

Carter G. A., Anderson C. P., **Funderburk W. R.**, Jeter G. W., Otvos E.G., Lucas K. L., 2018. Catastrophic storm impact and gradual recovery in the 2005-2010, post-storm period, Mississippi-Alabama barrier islands: Variation in total and vegetated land area and relationships of ecological communities with elevation. *Geomorphology*, in revision (ref. No.: GEOMOR-7281).

Anderson C.P., Carter G.A., **Funderburk W.R.**, 2016. The use of Aerial RGB imagery and LIDAR in comparing ecological habitats and geomorphic features on a natural versus man-made barrier island. *Remote Sensing*, 8 (7), 602. <http://dx.doi.org/10.3390/rs8070602>

Funderburk W.R., Carter G.A., Anderson C.P., 2015. Evaluating the Influence of Elevation and Impact of Hurricane Katrina on Radial Growth in Slash Pine (*Pinus elliotii* var. *elliotii* Engelm) on Cat Island, Mississippi. *Journal of Coastal Research*, 32 (3), 483-489. <http://dx.doi.org/10.2112/JCOASTRES-D-15-00038.1>

Funderburk W.R., 2016 COVER PHOTOGRAPH AND FRONT MATTER: INTERIOR SWALE OF THE SLOWLY-SUBSIDING CAT ISLAND, MISSISSIPPI, U.S.A. *Journal of Coastal Research*, 32, (3) pp. ii – viii. <http://dx.doi.org/10.2112/1551-5036-32.3.ii>

Conference Proceedings

Anderson, C. P., and **Funderburk, W. R.**, (Presenting Author) 2016. The “Cray-Z-ness” of ground returns in a *Juncus* marsh: Validating LIDAR bare elevations utilizing a real-time G.P.S network. Abstracts of the 4th Annual Mississippi Association for Spatial Technologies Meeting, October 20 – 21, 2016, Long Beach, MS.

Carter, G., C. Anderson, **Funderburk, W. R.**, (Presenting Author), G. Jeter, E. Otvos, K. Lucas, and N. Hopper. 2015. Vegetation cover and relationships of habitat-type with elevation on the Mississippi-Alabama Barrier Islands in the initial six years after Hurricane Katrina. 2015 Fall Meeting, American Geophysical Union, December 14-18, 2015, San Francisco, CA. Abstract number 81138.

Funderburk, W. R., Barrier island vegetation panel: Evaluating the influence of elevation and impact of Hurricane Katrina on radial growth in slash pine (*Pinus elliotii* var. *elliotii* Engelm.) on Cat Island, Mississippi. Abstracts of the 3rd Annual Mississippi Association for Spatial Technologies Meeting, October 22-23, 2015, Long Beach, MS.

Funderburk, W. R., and Carter, G. A. 2014. Mapping the distribution of Habitat-Types on Cat Island Mississippi. Abstracts of the 11th Annual Seven Hills Regional User Group for GIS, November 19 – 20, 2014, Tallahassee, FL.

Funderburk W.R., Carter G.A., Harley G.L., Determining Growth Response of *Pinus elliottii* to Hurricane Katrina (2005) on Cat Island Mississippi. Abstracts of the 99th Annual Ecological Society of America Meeting, August 10 – 15, 2014, Sacramento, CA.

Funderburk W.R., Carter G.A., Harley G.L., Forest Stand Dynamics on Siliciclastic, Barrier Islands: Determining Growth Responses of *Pinus elliottii* to Hurricane Katrina (2005) on Cat Island MS. American Geophysical Union Fall Meeting, San Francisco, CA, December 2013.

Funderburk, W.R., Transforming a University Campus with GIS: Creating Sustainable, Organic Permaculture, Edible Landscapes, Southeastern Division Association of American Geographers, 18 – 20 Nov. Asheville, NC. October 2012.

Selected Extramural Work and Research Projects

Assessment of crack detection in galvanized steel Davit Arms using narrow spectral band analysis and reflectance spectroscopy (Grant number-GR05975) (2018).

Establishment of a Remote Sensing Test Range at the Grand Bay National Estuarine Research Reserve (GBNERR): Phase II – including a new area of Hancock County. (Grant number-05575) (2015).

Establishment of a Remote Sensing Test Range at the Grand Bay National Estuarine Research Reserve (GBNERR): Phase I. (Grant number-GR05381) (2014).

Research and Teaching Interest

Geomatics
Geodesy
Remote Sensing
Kinematic Positioning
Physical Geography
Biogeography
Dendrochronology
Dendroecology
Coastal Systems

Teaching Experience

Adjunct Instructor, 3-D Positioning University of Southern Mississippi, Gulf Park	2016-present
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Adjunct Instructor, Remote Sensing University of Southern Mississippi, Gulf Park	2016-present
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Lab Instructor, Weather and Climate laboratory
2013
University of Southern Mississippi, Hattiesburg

Spring

Volunteer Lectures and Activities

Undergraduate mentor present	2015 –
Providing local municipalities with education on geodetic / GIS / remote sensing present (elevation, datums, benchmarks, standards and practices)	2015 –
Various guest lectures on barrier island vegetation and geomorphology present	2014 –
Various guest lectures on Remote Sensing / GPS present	2013 –

Honors and Awards

Army Commendation Medal (2)
Army Achievement Medal (2)
Certificate of Achievement
Global War on Terrorism Medal
Global Expeditionary War on Terrorism Medal
Good Conduct Medal
National Defense Medal
Expert Marksmanship Badge
Parachutists Badge

Organizations and Affiliations

United States Geospatial Intelligence Foundation (USGIF)
Mississippi Association for Spatial Technologies (MAST)
American Geophysical Union (AGU)
Ecological Society of America (ESA)

Gamma Theta Upsilon (Geographical Honors Society) (GTU)

APPENDIX B

Documents considered & Datasets Reviewed by William Funderburk

Directory Location and name: Expert Report Production File Input => Roadblock Data

“1_Master CAD Report - To Be Produced.csv”

“2_Roadblock Locations (Handwritten).xlsx”

“3_Unlisted Roadblocks.xlsx”

“1_Raw CAD Data and Clean Address Tab.xlsx”

“1_Geographic Coordinates For CAD Addresses.csv”

“2_Geographic Coordinates for Roadblock Locations (Handwritten).xlsx”

“3_Geographic Coordinates for Unlisted Roadblocks.csv”

Census tract shapefile for 2012-2017 and 2010 census block data obtained from US census bureau found at <https://www.census.gov/geo/maps-data/data/tiger-line.html>

Dr. Ricchetti’s Report

Dr. Ricchetti’s Deposition

APPENDIX C

Basic Stats on Datasets Reviewed by William Funderburk

1_Geographic_Coordinates_For_CAD_Addresses "NO SCORE"	Number of geocoded points	Percentage of total roadblocks
Locality	2185	7.02
POI	1012	3.25
PointAddress	9512	30.58
StreetAddress	4424	14.22
StreetAddressExt	408	1.31
StreetInt	8194	26.34
StreetName	5370	17.26
blank fields	4	0.01
TOTAL	31109	100.00

1_Geographic_Coordinates_For_CAD_AddressesSortedByScore>=90	number of geocoded points	Percentage of total roadblocks
Name_type	Quantity	percentage
Locality	399	1.57
POI	631	2.49
PointAddress	9471	37.38
StreetAddress	4273	16.87
StreetAddressExt	298	1.18
StreetInt	7755	30.61
StreetName	2508	9.90
TOTAL	25335	100.00

COMPILED UNIQUE ROADBLOCKS:

Dr. Ricchetti's 1,697 CAD Roadblocks and 146 "Additional Roadblocks" from Incident Reports

	attributes_x	attributes_y	clean_address	original_address	geoid	number_of_r oadblocks
1	-90.17705536	32.4002533	W COUNTY LINE RD AND I-220, MADISON COUNTY, MS	W COUNTY LINE RD / I-220 RID	28089030206	114
2	-90.03243256	32.61859131	DOBSON AVE AND YANDELL AVE, MADISON COUNTY, MS	DOBSON AVE / YANDELL AVE CAN	28089030600	78
3	-90.08860779	32.41168594	LOWER SPILLWAY RD, MADISON COUNTY, MS	LOWER SPILLWAY RD RID	28089030107	65
4	-90.10803986	32.40254593	OLD CANTON RD AND PINE KNOLL DR, MADISON COUNTY, MS	OLD CANTON RD / PINE KNOLL DR RID	28089030106	59
5	-90.01618958	32.61733246	HARGON ST AND COVINGTON DR, MADISON COUNTY, MS	HARGON ST / COVINGTON DR CAN	28089030600	48
6	-90.08585358	32.42646027	POST RD AND RICE RD, MADISON COUNTY, MS	POST RD / RICE RD CAN	28089030107	44
7	-90.08901215	32.70230103	OLD YAZOO CITY RD AND HWY 16, MADISON COUNTY, MS	OLD YAZOO CITY RD / HWY 16 CAN	28089030400	39
8	-90.03372955	32.64034653	W HWY 16 AND GREEN ACRES, MADISON COUNTY, MS	W HWY 16 / GREEN ACRES CAN	28089030600	38
9	-90.02046967	32.64770889	HWY 51 AND MORGAN RD, MADISON COUNTY, MS	HWY 51 / MORGAN RD CAN	28089030900	38
10	-89.98419189	32.63393784	HWY 43 AND GOODLOE RD, MADISON COUNTY, MS	HWY 43 / GOODLOE RD CAN	28089030900	34
11	-90.03488159	32.64033508	GREEN ACRES AND RAILROAD ST, MADISON COUNTY, MS	GREEN ACRES / RAILROAD ST CAN	28089030500	32
12	-89.94761658	32.54044724	PIPELINE RD AND HWY 43, MADISON COUNTY, MS	PIPELINE RD / HWY 43 CAN	28089030900	30
13	-89.9362793	32.62942886	HWY 16 E AND SHARON RD, MADISON COUNTY, MS	HWY 16 E / SHARON RD CAN	28089030900	25
14	-89.9750061	32.52461243	HWY 43 AND NATCHEZ TRACE PKWY, MADISON COUNTY, MS	HWY 43 / NATCHEZ TRACE PKWY CAN	28089030201	25
15	-90.31687927	32.57612228	KEARNEY PARK RD AND MIDDLE RD, MADISON COUNTY, MS	KEARNEY PARK RD / MIDDLE RD FLO	28089030302	23
16	-89.99530029	32.58216858	HWY 43 AND RANKIN RD, MADISON COUNTY, MS	HWY 43 / RANKIN RD CAN	28089030900	23
17	-90.17292786	32.45587158	LAKE CASTLE RD AND RICHARDSON RD, MADISON COUNTY, MS	LAKE CASTLE RD / RICHARDSON RD CAN	28089030204	21
18	-90.09313965	32.41199875	HARBOR AND LAKE HARBOR, MADISON COUNTY, MS	HARBOR / LAKE HARBOR CAN	28089030107	20
19	-89.98714447	32.61305618	HWY 16 AND AVONDALE RD, MADISON COUNTY, MS	HWY 16 / AVONDALE RD CAN	28089030600	19
20	-90.10651398	32.40514755	OLD CANTON RD AND WILLIAM BLVD, MADISON COUNTY, MS	OLD CANTON RD / WILLIAM BLVD RID	28089030106	19
21	-90.04395294	32.58721924	HWY 51 AND CORRECTIONS DR, MADISON COUNTY, MS	HWY 51 / CORRECTIONS DR CAN	28089030400	19
22	-90.10634613	32.41098785	HARBOUR PT XING AND OLD CANTON, MADISON COUNTY, MS	HARBOUR PT XING / OLD CANTON RID	28089030106	18
23	-90.00993347	32.66199875	HWY 51 AND STUMP BRIDGE RD, MADISON COUNTY, MS	HWY 51 / STUMP BRIDGE RD CAN	28089030900	18
24	-90.34701538	32.58657074	LIVINGSTON VERNON RD AND HWY 49, MADISON COUNTY, MS	LIVINGSTON VERNON RD / HWY 49 CAN	28089030302	17
25	-90.13207245	32.4068222	TOWNE CENTER AND WHEATLEY, MADISON COUNTY, MS	TOWNE CENTER / WHEATLEY RID	28089030106	17
26	-90.03994751	32.61872864	RAILROAD ST AND GEORGE WASHINGTO, MADISON COUNTY, MS	RAILROAD ST / GEORGE WASHINGTO CAN	28089030500	16
27	-90.0069046	32.59394073	S HWY 43 AND CANTON PARKWAY, MADISON COUNTY, MS	S HWY 43 / CANTON PARKWAY CAN	28089030800	15
28	-90.05064392	32.61831284	388 RICKS DR, MADISON COUNTY, MS	388 RICKS DR CAN	28089030500	15
29	-90.21575928	32.55335999	HWY 463 AND HWY 22, MADISON COUNTY, MS	HWY 463 / HWY 22 CAN	28089030400	14
30	-90.05895233	32.60921478	W PEACE ST AND PLUMNER DR, MADISON COUNTY, MS	W PEACE ST / PLUMNER DR CAN	28089030500	14
31	-90.03977966	32.56027222	N OLD CANTON RD AND ENDRIS, MADISON COUNTY, MS	N OLD CANTON RD / ENDRIS CAN	28089030400	13
32	-90.03453064	32.62374878	N UNION ST AND MARTIN LUTHER KING, MADISON COUNTY, MS	N UNION ST / MARTIN LUTHER KING CAN	28089030600	13
33	-90.19194031	32.52423477	HWY 463 AND GLUCKSTADT RD, MADISON COUNTY, MS	HWY 463 / GLUCKSTADT RD MAD	28089030301	12
34	-89.75151062	32.76044846	HWY 43 AND CAUTHEN RD, MADISON COUNTY, MS	HWY 43 / CAUTHEN RD CAN	28089031000	12
35	-90.05486298	32.6162529	FOLEY AVE AND KING RANCH RD, MADISON COUNTY, MS	FOLEY AVE / KING RANCH RD CAN	28089030500	12
36	-90.04443359	32.61504745	MARTIN LUTHER KING DR AND N UNIO, MADISON COUNTY, MS	MARTIN LUTHER KING DR / N UNIO CAN	28089030500	11
37	-90.19989014	32.42080688	LIVINGSTON RD AND OLD AGENCY RD, MADISON COUNTY, MS	LIVINGSTON RD / OLD AGENCY RD CAN	28089030206	11
38	-90.08933258	32.60985184	VIRLILIA RD AND OLD YAZOO CITY R, MADISON COUNTY, MS	VIRLILIA RD / OLD YAZOO CITY R CAN	28089030400	11

COMPILED UNIQUE ROADBLOCKS:

Dr. Ricchetti's 1,697 CAD Roadblocks and 146 "Additional Roadblocks" from Incident Reports

	attributes_x	attributes_y	clean_address	original_address	geoid	number_of_r oadblocks
39	-90.17658997	32.40026093	I-220 AND W COUNTY LINE RD, MADISON COUNTY, MS	I-220 / W COUNTY LINE RD CAN	28089030206	11
40	-89.96871185	32.84815598	HWY 51 AND HWY 17, MADISON COUNTY, MS	HWY 51 / HWY 17 CAN	28089031000	11
41	-89.94247437	32.71290207	SHARON RD AND STUMP BRIDGE RD, MADISON COUNTY, MS	SHARON RD / STUMP BRIDGE RD CAN	28089030900	11
42	-90.08634186	32.43252563	WRIGHTS MILL DR AND RICE RD, MADISON COUNTY, MS	WRIGHTS MILL DR / RICE RD MAD	28089030101	11
43	-90.18656921	32.45495224	N LIVINGSTON RD AND LAKE CASTLE RD, MADISON COUNTY, MS	N LIVINGSTON RD / LAKE CASTLE RD MAD	28089030302	10
44	-89.93623352	32.65844345	HWY 43 AND SHARON RD, MADISON COUNTY, MS	HWY 43 / SHARON RD CAN	28089030900	10
45	-90.27289581	32.49578857	ROBINSON SPRINGS RD AND POCAHONTAS, MADISON COUNTY, MS	ROBINSON SPRINGS RD / POCAHONTAS FLO	28089030302	10
46	-90.10394287	32.4017334	PINE KNOLL DR, MADISON COUNTY, MS	PINE KNOLL DR RID	28089030108	9
47	-90.04322815	32.62371826	619 MARTIN LUTHER KING DR, MADISON COUNTY, MS	619 MARTIN LUTHER KING DR CAN	28089030500	9
48	-90.07125092	32.53917694	HWY 51 AND SOWELL RD, MADISON COUNTY, MS	HWY 51 / SOWELL RD CAN	28089030400	9
49	-89.97753906	32.52706146	HWY 43 AND YANDELL RD, MADISON COUNTY, MS	HWY 43 / YANDELL RD CAN	28089030201	9
50	-90.24606323	32.56061554	LIVINGSTON VERNON RD AND STOKES, MADISON COUNTY, MS	LIVINGSTON VERNON RD / STOKES CAN	28089030302	8
51	-89.99343109	32.51694489	YANDELL RD AND TWELVE OAKS TRACE, MADISON COUNTY, MS	YANDELL RD / TWELVE OAKS TRACE CAN	28089030201	8
52	-90.06342316	32.46509552	HOY RD AND OLD RICE RD, MADISON COUNTY, MS	HOY RD / OLD RICE RD MAD	28089030201	8
53	-90.0888443	32.4116745	SPILLWAY RD AND BREAKERS LN, MADISON COUNTY, MS	SPILLWAY RD / BREAKERS LN RID	28089030108	8
54	-90.04675293	32.6185379	BOYD ST AND GEORGE WASHINGTON AV, MADISON COUNTY, MS	BOYD ST / GEORGE WASHINGTON AV CAN	28089030500	8
55	-90.037323	32.62368774	JAMES ST AND MARTIN LUTHER KING, MADISON COUNTY, MS	JAMES ST / MARTIN LUTHER KING CAN	28089030600	8
56	-90.00255585	32.69113922	HWY 51 AND DAVIS CROSSING, MADISON COUNTY, MS	HWY 51 / DAVIS CROSSING CAN	28089030900	7
57	-90.13653564	32.58304977	HWY 22 AND CATLETT RD, MADISON COUNTY, MS	HWY 22 / CATLETT RD CAN	28089030400	7
58	-89.99523163	32.5603714	HWY 43 AND ENDRIS RD, MADISON COUNTY, MS	HWY 43 / ENDRIS RD CAN	28089030900	7
59	-90.14375305	32.42818069	NATCHEZ TRACE PKWY AND I-55, MADISON COUNTY, MS	NATCHEZ TRACE PKWY / I-55 RID	28089030105	7
60	-90.05764008	32.472332	OLD RICE RD AND SHADOW HILL DR, MADISON COUNTY, MS	OLD RICE RD / SHADOW HILL DR CAN	28089030201	7
61	-90.03805542	32.51933289	OLD CANTON RD AND YANDELL RD, MADISON COUNTY, MS	OLD CANTON RD / YANDELL RD CAN	28089030400	7
62	-90.0486145	32.58060455	HWY 51 AND NISSAN PKWY, MADISON COUNTY, MS	HWY 51 / NISSAN PKWY CAN	28089030400	7
63	-90.17767334	32.53667068	124 N I-55, MADISON COUNTY, MS	124 N I-55 CAN	28089030400	7
64	-90.20085907	32.44431686	LAKE CAVALIER RD AND N LIVINGSTO, MADISON COUNTY, MS	LAKE CAVALIER RD / N LIVINGSTO MAD	28089030302	7
65	-90.30366516	32.51155472	HWY 49 AND PETRIFIED FOREST RD, MADISON COUNTY, MS	HWY 49 / PETRIFIED FOREST RD CAN	28089030302	6
66	-90.08623505	32.4353714	BREEZY HILL DR AND RICE RD, MADISON COUNTY, MS	BREEZY HILL DR / RICE RD MAD	28089030101	6
67	-90.1235199	32.42500305	RICE RD AND PEAR ORCHARD RD, MADISON COUNTY, MS	RICE RD / PEAR ORCHARD RD RID	28089030104	6
68	-90.10031128	32.40473175	WILLIAM BLVD, MADISON COUNTY, MS	WILLIAM BLVD CAN	28089030108	6
69	-90.04859161	32.62272263	HOLMES AVE AND MACE ST, MADISON COUNTY, MS	HOLMES AVE / MACE ST CAN	28089030500	6
70	-90.3325119	32.57169342	HWY 49 AND MIDDLE RD, MADISON COUNTY, MS	HWY 49 / MIDDLE RD CAN	28089030302	6
71	-89.99081421	32.74888611	HWY 51 AND WAY RD, MADISON COUNTY, MS	HWY 51 / WAY RD CAN	28089031000	6
72	-90.03845215	32.62369537	RAILROAD ST AND MARTIN LUTHER KI, MADISON COUNTY, MS	RAILROAD ST / MARTIN LUTHER KI CAN	28089030500	6
73	-90.03852844	32.62369537	MARTIN LUTHER KING DR AND RAILRO, MADISON COUNTY, MS	MARTIN LUTHER KING DR / RAILRO CAN	28089030500	6
74	-90.03063965	32.62255859	RICHARD CIR, MADISON COUNTY, MS	RICHARD CIR CAN	28089030600	5
75	-89.87284088	32.69706345	HWY 43 AND SULPHUR SPRINGS RD, MADISON COUNTY, MS	HWY 43 / SULPHUR SPRINGS RD CAN	28089030900	5
76	-90.13625336	32.55327988	STOUT RD AND CATLETT RD, MADISON COUNTY, MS	STOUT RD / CATLETT RD CAN	28089030400	5

COMPILED UNIQUE ROADBLOCKS:

Dr. Ricchetti's 1,697 CAD Roadblocks and 146 "Additional Roadblocks" from Incident Reports

	attributes_x	attributes_y	clean_address	original_address	geoid	number_of_r oadblocks
77	-90.10901642	32.41405106	LAKE HARBOUR DRIVE AND RANKIN, MADISON COUNTY, MS	Lake Harbour Drive / Rankin	28089030104	5
78	-90.08938599	32.59406662	OLD JACKSON RD AND HWY 22, MADISON COUNTY, MS	OLD JACKSON RD / HWY 22 CAN	28089030400	5
79	-90.02677917	32.6385994	RR AND GREEN ACRES, MADISON COUNTY, MS	RR / GREEN ACRES CAN	28089030600	5
80	-90.15769196	32.51791	GLUCKSTADT RD AND DEWEES RD, MADISON COUNTY, MS	GLUCKSTADT RD / DEWEES RD CAN	28089030301	5
81	-90.09997559	32.58411407	HWY 22 AND CALHOUN PKWY, MADISON COUNTY, MS	HWY 22 / CALHOUN PKWY CAN	28089030400	5
82	-90.04470825	32.58623886	2935 HWY 51, MADISON COUNTY, MS	2935 HWY 51 CAN	28089030400	5
83	-90.17539978	32.42944717	122 NATCHEZ TRACE PKWY, MADISON COUNTY, MS	122 NATCHEZ TRACE PKWY CAN	28089030205	5
84	-89.90604401	32.63900375	HWY 16 AND RATLIFF FERRY RD, MADISON COUNTY, MS	HWY 16 / RATLIFF FERRY RD CAN	28089030900	5
85	-89.8094635	32.7156105	HWY 17 AND SULPHUR SPRINGS RD, MADISON COUNTY, MS	HWY 17 / SULPHUR SPRINGS RD CAN	28089031000	5
86	-90.36658478	32.49875641	HWY 22 AND SPRING CREEK RD, MADISON COUNTY, MS	HWY 22 / SPRING CREEK RD CAN	28089030302	5
87	-90.04675293	32.61502075	BOYD ST AND WEST NORTH, MADISON COUNTY, MS	BOYD ST / WEST NORTH CAN	28089030500	5
88	-90.30413818	32.54594421	HWY 22 AND BANNERMAN DR, MADISON COUNTY, MS	HWY 22 / BANNERMAN DR FLO	28089030302	5
89	-90.13199615	32.51691818	GLUCKSTADT RD AND CATLETT RD, MADISON COUNTY, MS	GLUCKSTADT RD / CATLETT RD CAN	28089030400	4
90	-90.09339142	32.58893585	NISSAN PKWY AND HWY 22, MADISON COUNTY, MS	NISSAN PKWY / HWY 22 CAN	28089030400	4
91	-90.04230499	32.61014938	CANAL ST AND W ACADEMY ST, MADISON COUNTY, MS	CANAL ST / W ACADEMY ST CAN	28089030500	4
92	-90.08905029	32.54971313	OLD JACKSON RD AND I-55, MADISON COUNTY, MS	OLD JACKSON RD / I-55 MAD	28089030400	4
93	-90.03762817	32.62757874	RAILROAD ST, MADISON COUNTY, MS	RAILROAD ST CAN	28089030500	4
94	-90.04049683	32.4914856	N OLD CANTON RD AND DAVE BROWN RD, MADISON COUNTY, MS	N OLD CANTON RD / DAVE BROWN RD CAN	28089030201	4
95	-89.83875275	32.7822113	LORING RD AND HWY 17, MADISON COUNTY, MS	LORING RD / HWY 17 CAN	28089031000	4
96	-90.04421997	32.62126541	MLK AND ADELINE ST, MADISON COUNTY, MS	MLK / ADELINE ST CAN	28089030500	4
97	-89.82128906	32.74313354	HWY 17 AND HWY 43, MADISON COUNTY, MS	HWY 17 / HWY 43 CAN	28089031000	4
98	-90.07178497	32.51709747	YANDELL RD AND CLARKDELL RD, MADISON COUNTY, MS	YANDELL RD / CLARKDELL RD CAN	28089030400	4
99	-90.30883026	32.54263687	RAILROAD AV AND CMU, MADISON COUNTY, MS	RAILROAD AV / CMU CAN	28089030302	4
100	-90.07054138	32.51710892	YANDELL RD AND MADISON CROSSING, MADISON COUNTY, MS	YANDELL RD / MADISON CROSSING MAD	28089030400	4
101	-90.18199921	32.40019989	W COUNTY LINE AND HIGHLAND COLONY, MADISON COUNTY, MS	W COUNTY LINE / HIGHLAND COLONY CAN	28089030206	4
102	-90.04026794	32.61505508	RAILROAD ST AND W NORTH ST, MADISON COUNTY, MS	RAILROAD ST / W NORTH ST CAN	28089030500	4
103	-90.0442276	32.61856461	GEORGE WASHINGTON AVE AND KING R, MADISON COUNTY, MS	GEORGE WASHINGTON AVE / KING R CAN	28089030500	4
104	-90.03175354	32.62266159	RICHARD CIR AND DOBSON AVE, MADISON COUNTY, MS	RICHARD CIR / DOBSON AVE CAN	28089030600	4
105	-89.98655701	32.77806473	HWY 51 AND LORING RD, MADISON COUNTY, MS	HWY 51 / LORING RD CAN	28089031000	4
106	-90.03939819	32.6113472	CAMERON ST AND W FULTON ST, MADISON COUNTY, MS	CAMERON ST / W FULTON ST CAN	28089030700	4
107	-89.76596069	32.74020004	SULPHUR SPRING RD AND GIN RD, MADISON COUNTY, MS	SULPHUR SPRING RD / GIN RD CAN	28089030900	4
108	-90.09546661	32.49241257	HWY 51 AND GREEN OAK LN, MADISON COUNTY, MS	HWY 51 / GREEN OAK LN CAN	28089030204	4
109	-90.10649109	32.44726944	OLD CANTON RD AND CALUMET DR, MADISON COUNTY, MS	OLD CANTON RD / CALUMET DR CAN	28089030101	4
110	-90.10624695	32.41098785	HARBOUR POINTE CROSSING AND NORT, MADISON COUNTY, MS	HARBOUR POINTE CROSSING / NORT RID	28089030108	4
111	-90.26583862	32.55144119	HWY 22 AND ANDOVER DR, MADISON COUNTY, MS	HWY 22 / ANDOVER DR CAN	28089030302	4
112	-90.28811646	32.58969116	LIVINGSTON VERNON RD AND ST CHAR, MADISON COUNTY, MS	LIVINGSTON VERNON RD / ST CHAR FLO	28089030302	3
113	-90.09117126	32.46505356	HOY RD AND RICE RD, MADISON COUNTY, MS	HOY RD / RICE RD MAD	28089030202	3
114	-90.16107941	32.44203186	STEED RD AND RICHARDSON RD, MADISON COUNTY, MS	STEED RD / RICHARDSON RD CAN	28089030205	3

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	attributes_x	attributes_y	clean_address	original_address	geoid	number_of_r oadblocks
115	-90.01182556	32.63319778	FINNEY RD AND MORGAN RD, MADISON COUNTY, MS	FINNEY RD / MORGAN RD CAN	28089030600	3
116	-89.93619537	32.6185112	ROBINSON RD AND SHARON RD, MADISON COUNTY, MS	ROBINSON RD / SHARON RD CAN	28089030900	3
117	-90.18070984	32.49436569	REUNION PKWY AND HWY 463, MADISON COUNTY, MS	REUNION PKWY / HWY 463 MAD	28089030301	3
118	-90.200737	32.4839325	ROBINSON SPRINGS RD AND POC, MADISON COUNTY, MS	ROBINSON SPRINGS RD / POC CAN	28089030302	3
119	-90.03203583	32.63382339	1415 W HWY 16, MADISON COUNTY, MS	1415 W HWY 16 CAN	28089030600	3
120	-90.19274139	32.5337944	HWY 463 AND STRIBLING RD, MADISON COUNTY, MS	HWY 463 / STRIBLING RD MAD	28089030400	3
121	-90.02981567	32.63196564	W HWY 16 AND HWY 51, MADISON COUNTY, MS	W HWY 16 / HWY 51 CAN	28089030600	3
122	-90.10951996	32.46508789	HWY 463 AND MADISON MIDDLE, MADISON COUNTY, MS	HWY 463 / MADISON MIDDLE CAN	28089030203	3
123	-90.04636383	32.62124634	ADELINE ST AND SINGLETON ST, MADISON COUNTY, MS	ADELINE ST / SINGLETON ST CAN	28089030500	3
124	-89.96963501	32.52200317	HWY 43 AND TURCOTTE LAB DR, MADISON COUNTY, MS	HWY 43 / TURCOTTE LAB DR CAN	28089030900	3
125	-89.76803589	32.75790405	HWY 43 AND GIN RD, MADISON COUNTY, MS	HWY 43 / GIN RD CAR	28089031000	3
126	-90.04845428	32.58081055	HWY 51 AND HWY 16 W, MADISON COUNTY, MS	HWY 51 / HWY 16 W CAN	28089030400	3
127	-90.07056427	32.51711655	300 YANDELL RD, MADISON COUNTY, MS	300 YANDELL RD CAN	28089030400	3
128	-90.03488922	32.61563873	HWY 16 AND HWY 51, MADISON COUNTY, MS	HWY 16 / HWY 51 CAN	28089030600	3
129	-90.05050659	32.54238892	SMITH CARR AND E SOWELL RD, MADISON COUNTY, MS	SMITH CARR / E SOWELL RD CAN	28089030400	3
130	-90.28852081	32.51951981	POCAHONTAS RD AND MT LEOPARD RD, MADISON COUNTY, MS	POCAHONTAS RD / MT LEOPARD RD FLO	28089030302	3
131	-90.04566193	32.61855698	GEORGE WASHINGTON AVE AND RR, MADISON COUNTY, MS	GEORGE WASHINGTON AVE / RR CAN	28089030500	3
132	-90.02170563	32.6230278	INDUSTRIAL DR AND MATTHEWS AVE, MADISON COUNTY, MS	INDUSTRIAL DR / MATTHEWS AVE CAN	28089030600	3
133	-90.18177032	32.40090942	HIGHLAND COLONY PKWY, MADISON COUNTY, MS	HIGHLAND COLONY PKWY MAD	28089030206	3
134	-90.05478668	32.62356186	HOLMES AVE AND KING RANCH RD, MADISON COUNTY, MS	HOLMES AVE / KING RANCH RD CAN	28089030500	3
135	-90.31085968	32.58965683	LIVINGSTON VERNON RD AND HARRIS, MADISON COUNTY, MS	LIVINGSTON VERNON RD / HARRIS FLO	28089030302	3
136	-90.03755951	32.69113922	WAY RD AND DAVIS CROSSING RD, MADISON COUNTY, MS	WAY RD / DAVIS CROSSING RD CAN	28089030400	3
137	-90.02915192	32.62176132	WILSON ST AND RICHARD CIR, MADISON COUNTY, MS	WILSON ST / RICHARD CIR CAN	28089030600	3
138	-89.83577728	32.6610527	HWY 16 EAST AND PAT LUCKETT RD, MADISON COUNTY, MS	HWY 16 EAST / PAT LUCKETT RD CAN	28089030900	2
139	-90.20282745	32.40014267	N LIVINGSTON RD AND COUNTY LINE, MADISON COUNTY, MS	N LIVINGSTON RD / COUNTY LINE CAN	28089030206	2
140	-89.74710083	32.67307663	WALNUT RD AND NATCHEZ TRACE PKWY, MADISON COUNTY, MS	WALNUT RD / NATCHEZ TRACE PKWY CAN	28089030900	2
141	-90.12995911	32.42630768	HWY 51 AND NATCHEZ TRACE, MADISON COUNTY, MS	HWY 51 / NATCHEZ TRACE RID	28089030101	2
142	-90.05891418	32.67737961	N HWY 55 AND 124, MADISON COUNTY, MS	N HWY 55 / 124 CAN	28089030400	2
143	-90.06362915	32.58545303	NISSAN PKWY AND NISSAN DR, MADISON COUNTY, MS	NISSAN PKWY / NISSAN DR CAN	28089030400	2
144	-90.03809357	32.52589035	OLD CANTON RD AND HARVEY CROSSIN, MADISON COUNTY, MS	OLD CANTON RD / HARVEY CROSSIN CAN	28089030400	2
145	-89.87010193	32.69685745	SULPHUR SPRINGS RD AND POTLUCK R, MADISON COUNTY, MS	SULPHUR SPRINGS RD / POTLUCK R CAN	28089030900	2
146	-90.0400238	32.61634064	RAILROAD ST AND BOWMAN ST, MADISON COUNTY, MS	RAILROAD ST / BOWMAN ST CAN	28089030500	2
147	-89.99324036	32.53899765	HWY 43 AND COTTON BLOSSOM RD, MADISON COUNTY, MS	HWY 43 / COTTON BLOSSOM RD CAN	28089030900	2
148	-89.85848236	32.60366058	RATLIFF FERRY RD AND BOYD DR, MADISON COUNTY, MS	RATLIFF FERRY RD / BOYD DR CAN	28089030900	2
149	-90.04962158	32.6243515	707 MACE ST, MADISON COUNTY, MS	707 MACE ST CAN	28089030500	2
150	-90.07274628	32.48779678	CLARKDELL RD AND GREEN OAK LN, MADISON COUNTY, MS	CLARKDELL RD / GREEN OAK LN CAN	28089030201	2
151	-90.072052	32.51708221	YANDELL RD AND BRACEY RD, MADISON COUNTY, MS	YANDELL RD / BRACEY RD CAN	28089030400	2
152	-90.08808136	32.54776382	NISSAN DR AND OLD JACKSON RD, MADISON COUNTY, MS	NISSAN DR / OLD JACKSON RD CAN	28089030400	2

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Dr. Ricchetti's 1,697 CAD Roadblocks and 146 "Additional Roadblocks" from Incident Reports

	attributes_x	attributes_y	clean_address	original_address	geoid	number_of_r oadblocks
153	-90.05884552	32.56297302	HWY 51 AND LINKS DR, MADISON COUNTY, MS	HWY 51 / LINKS DR CAN	28089030400	2
154	-90.19945526	32.42228317	N LIVINGSTON RD AND NATCHEZ TRACE BRIDGE, MADISON COUNTY, MS	N LIVINGSTON RD / NATCHEZ TRACE BRIDGE MAD	28089030206	2
155	-90.17494202	32.56565475	MCMILLON RD AND HWY 22, MADISON COUNTY, MS	MCMILLON RD / HWY 22 MAD	28089030400	2
156	-90.07836914	32.54092026	SOWELL RD AND SOWELL RD, MADISON COUNTY, MS	SOWELL RD / SOWELL RD MAD	28089030400	2
157	-89.96032715	32.62166977	E HWY 16 AND ROYAL OAK RD, MADISON COUNTY, MS	E HWY 16 / ROYAL OAK RD CAN	28089030600	2
158	-90.029953	32.61016083	ACADEMY ST AND LYON ST, MADISON COUNTY, MS	ACADEMY ST / LYON ST CAN	28089030800	2
159	-90.0947113	32.41666031	HARBOR DR, MADISON COUNTY, MS	HARBOR DR CAN	28089030107	2
160	-90.22270203	32.43442917	GREENS CROSSING RD, MADISON COUNTY, MS	GREENS CROSSING RD MAD	28089030302	2
161	-90.07616425	32.51581192	YANDELL RD AND CLARKDELL RD EXT, MADISON COUNTY, MS	YANDELL RD / CLARKDELL RD EXT CAN	28089030400	2
162	-90.0364151	32.60405731	UNION ST AND W DINKINS ST, MADISON COUNTY, MS	UNION ST / W DINKINS ST CAN	28089030700	2
163	-90.33125305	32.53838348	HWY 22 AND CHILDRESS LN, MADISON COUNTY, MS	HWY 22 / CHILDRESS LN CAN	28089030302	2
164	-90.22629547	32.47418594	COKER RD AND LAKE CAVALIER RD, MADISON COUNTY, MS	COKER RD / LAKE CAVALIER RD MAD	28089030302	2
165	-89.9838028	32.79603577	HWY 51 AND 2 J'S, MADISON COUNTY, MS	HWY 51 / 2 J'S CAN	28089031000	2
166	-90.03491211	32.60403824	S LIBERTY ST AND W DINKINS ST, MADISON COUNTY, MS	S LIBERTY ST / W DINKINS ST CAN	28089030700	2
167	-90.05690765	32.68186188	W HWY 16 AND I-55, MADISON COUNTY, MS	W HWY 16 / I-55 CAN	28089030400	2
168	-90.05068207	32.60635376	WESTSIDE DR AND ROSEBUD DR, MADISON COUNTY, MS	WESTSIDE DR / ROSEBUD DR CAN	28089030500	2
169	-90.08909607	32.55703354	OLD JACKSON RD AND STOUT RD, MADISON COUNTY, MS	OLD JACKSON RD / STOUT RD CAN	28089030400	2
170	-90.05153656	32.62368774	1106 HOLMES AV, MADISON COUNTY, MS	1106 HOLMES AV CAN	28089030500	2
171	-89.90175629	32.6204567	RATLIFF FERRY RD AND ROBINSON RD, MADISON COUNTY, MS	RATLIFF FERRY RD / ROBINSON RD CAN	28089030900	2
172	-90.08938599	32.5393219	W SOWELL RD AND OLD JACKSON RD, MADISON COUNTY, MS	W SOWELL RD / OLD JACKSON RD CAN	28089030400	2
173	-90.09276581	32.42120743	831 RICE RD, MADISON COUNTY, MS	831 RICE RD RID	28089030107	2
174	-90.03481293	32.61856461	YANDELL AVE AND N LIBERTY ST, MADISON COUNTY, MS	YANDELL AVE / N LIBERTY ST CAN	28089030600	2
175	-90.02471161	32.62008667	INDUSTRIAL DR AND LINCOLN ST, MADISON COUNTY, MS	INDUSTRIAL DR / LINCOLN ST CAN	28089030600	2
176	-90.08908081	32.64042664	HEINDL RD AND OLD YAZOO CITY RD, MADISON COUNTY, MS	HEINDL RD / OLD YAZOO CITY RD CAN	28089030400	2
177	-90.13915253	32.49761581	BOZEMAN RD AND REUNION ANNANDALE, MADISON COUNTY, MS	BOZEMAN RD / REUNION ANNANDALE CAN	28089030301	2
178	-90.04214478	32.61341858	N CANAL ST AND FRANKLIN ST, MADISON COUNTY, MS	N CANAL ST / FRANKLIN ST CAN	28089030500	2
179	-90.00770569	32.60390472	HWY 43 AND DINKINS ST, MADISON COUNTY, MS	HWY 43 / DINKINS ST CAN	28089030800	2
180	-90.05139923	32.62360001	HOLMES AV, MADISON COUNTY, MS	HOLMES AV CAN	28089030500	2
181	-90.0555191	32.62804031	DORIS FRANCIS BLVD AND HARRINGTO, MADISON COUNTY, MS	DORIS FRANCIS BLVD / HARRINGTO CAN	28089030500	2
182	-90.02713013	32.61854553	LINCOLN ST AND YANDELL AVE, MADISON COUNTY, MS	LINCOLN ST / YANDELL AVE CAN	28089030600	2
183	-90.1570816	32.4787941	HWY 463 AND MANNSDALE, MADISON COUNTY, MS	HWY 463 / MANNSDALE CAN	28089030204	2
184	-90.08881378	32.5850029	NISSAN PKWY AND OLD JACKSON RD, MADISON COUNTY, MS	NISSAN PKWY / OLD JACKSON RD CAN	28089030400	2
185	-90.39897156	32.54275894	COX FERRY RD AND PHILLIPS RD, MADISON COUNTY, MS	COX FERRY RD / PHILLIPS RD CAN	28089030302	1
186	-90.06362915	32.5854454	NISSAN DR AND NISSAN PKWY, MADISON COUNTY, MS	NISSAN DR / NISSAN PKWY CAN	28089030400	1
187	-90.09473419	32.54017639	SOWELL RD AND I-55, MADISON COUNTY, MS	SOWELL RD / I-55 MAD	28089030400	1
188	-90.10643768	32.45043564	OLD CANTON RD AND ST AUGUSTINE D, MADISON COUNTY, MS	OLD CANTON RD / ST AUGUSTINE D MAD	28089030101	1
189	-90.19879913	32.43163681	N LIVINGSTON RD AND COU, MADISON COUNTY, MS	N LIVINGSTON RD / COU CAN	28089030302	1
190	-90.08906555	32.57499695	OLD JACKSON RD AND BEAL RD, MADISON COUNTY, MS	OLD JACKSON RD / BEAL RD CAN	28089030400	1

COMPILED UNIQUE ROADBLOCKS:

Dr. Ricchetti's 1,697 CAD Roadblocks and 146 "Additional Roadblocks" from Incident Reports

	attributes_x	attributes_y	clean_address	original_address	geoid	number_of_r oadblocks
191	-90.10414886	32.506073	PARKWAY EAST AND INDUSTRIAL DR S, MADISON COUNTY, MS	PARKWAY EAST / INDUSTRIAL DR S MAD	28089030204	1
192	-89.85935974	32.6529541	E HWY 16 AND HOGUE RD, MADISON COUNTY, MS	E HWY 16 / HOGUE RD CAN	28089030900	1
193	-90.07460022	32.51259613	CLARKDELL RD EXT AND YAN, MADISON COUNTY, MS	CLARKDELL RD EXT / YAN CAN	28089030201	1
194	-90.11701202	32.45050812	HWY 51 AND ST AUGUSTINE DR, MADISON COUNTY, MS	HWY 51 / ST AUGUSTINE DR MAD	28089030101	1
195	-90.0770874	32.54249954	W SOWELL RD AND RR TRACKS, MADISON COUNTY, MS	W SOWELL RD / RR TRACKS MAD	28089030400	1
196	-90.16146851	32.51902771	463 AND GLUCKSTADT RD, MADISON COUNTY, MS	463 / GLUCKSTADT RD CAN	28089030301	1
197	-90.05438232	32.6162529	FOLEY AVE AND SUNSET AVE, MADISON COUNTY, MS	FOLEY AVE / SUNSET AVE CAN	28089030500	1
198	-90.03640747	32.60582352	S UNION ST AND CAR WASH, MADISON COUNTY, MS	S UNION ST / CAR WASH CAN	28089030700	1
199	-90.05147552	32.56248474	147 LINKS DR, MADISON COUNTY, MS	147 LINKS DR CAN	28089030400	1
200	-89.84157562	32.62989426	MIGGINS RD AND ROBINSON RD, MADISON COUNTY, MS	MIGGINS RD / ROBINSON RD CAN	28089030900	1
201	-90.03670502	32.64455032	130 JOHNSON HILL RD, MADISON COUNTY, MS	130 Johnson Hill Rd	28089030400	1
202	-90.30957031	32.54311752	KEARNEY PARK RD AND HWY 22, MADISON COUNTY, MS	KEARNEY PARK RD / HWY 22 CAN	28089030302	1
203	-89.97251129	32.52275848	HWY 43 AND BROWNS LANDING RD, MADISON COUNTY, MS	HWY 43 / BROWNS LANDING RD CAN	28089030201	1
204	-90.14530182	32.40590668	HWY 51 HWY 17, MADISON COUNTY, MS	HWY 51 HWY 17 CAN	28089030105	1
205	-90.11557007	32.40314865	NORTHPARK DR AND AVERY BLVD, MADISON COUNTY, MS	NORTHPARK DR / AVERY BLVD RID	28089030106	1
206	-90.04945374	32.61852646	RR AND GEORGE WASHINGTON, MADISON COUNTY, MS	RR / GEORGE WASHINGTON CAN	28089030500	1
207	-89.98095703	32.53079605	HWY 43 AND RAMAGE RD, MADISON COUNTY, MS	HWY 43 / RAMAGE RD CAN	28089030900	1
208	-90.02631378	32.60898972	ADAMS STREET AND PEAR STREET, MADISON COUNTY, MS	Adams Street / Pear Street	28089030800	1
209	-90.02433777	32.6200943	INDUSTRIAL DR AND MILLER ST, MADISON COUNTY, MS	INDUSTRIAL DR / MILLER ST CAN	28089030600	1
210	-90.14375305	32.54634857	CAROLINE BLVD AND BELLEVUE DR, MADISON COUNTY, MS	CAROLINE BLVD / BELLEVUE DR CAN	28089030400	1
211	-90.05475616	32.63266754	HEINDL RD AND KING RANCH RD, MADISON COUNTY, MS	HEINDL RD / KING RANCH RD CAN	28089030500	1
212	-90.05071259	32.61851883	GEORGE WASHINGTON AVE AND RICKS, MADISON COUNTY, MS	GEORGE WASHINGTON AVE / RICKS CAN	28089030500	1
213	-90.08623505	32.43535995	RICE AND WOODS CROSSING BLVD, MADISON COUNTY, MS	RICE / WOODS CROSSING BLVD CAN	28089030101	1
214	-90.04423523	32.61856461	MARTIN LUTHER KING DR AND GEORGE, MADISON COUNTY, MS	MARTIN LUTHER KING DR / GEORGE CAN	28089030500	1
215	-90.13108826	32.42473221	RICE RD AND HWY 51, MADISON COUNTY, MS	RICE RD / HWY 51 CAN	28089030105	1
216	-90.10944366	32.57920837	HWY 22 AND LAKESHIRE PKWY, MADISON COUNTY, MS	HWY 22 / LAKESHIRE PKWY CAN	28089030400	1
217	-90.0565567	32.6100235	PEACE ST AND FULTON ST, MADISON COUNTY, MS	PEACE ST / FULTON ST CAN	28089030500	1
218	-89.84963989	32.59727859	NATCHEZ TRACE AND RATLIFF FERRY, MADISON COUNTY, MS	NATCHEZ TRACE / RATLIFF FERRY CAN	28089030900	1
219	-90.03639221	32.61136627	UNION ST AND W FULTON ST, MADISON COUNTY, MS	UNION ST / W FULTON ST CAN	28089030700	1
220	-90.03140259	32.62365723	DOBSON AVE AND SHERWOOD DR, MADISON COUNTY, MS	DOBSON AVE / SHERWOOD DR CAN	28089030600	1
221	-90.04206848	32.61503601	CANAL ST AND W NORTH ST, MADISON COUNTY, MS	CANAL ST / W NORTH ST CAN	28089030500	1
222	-89.83123016	32.67559052	LOTTVILLE RD AND JOHN DAY RD, MADISON COUNTY, MS	LOTTVILLE RD / JOHN DAY RD CAN	28089030900	1
223	-90.04634094	32.60636902	CAUTHEN ST AND ROSEBUD DR, MADISON COUNTY, MS	CAUTHEN ST / ROSEBUD DR CAN	28089030500	1
224	-90.03804016	32.53884125	N OLD CANTON RD AND COTTON BLOSSOM, MADISON COUNTY, MS	N OLD CANTON RD / COTTON BLOSSOM CAN	28089030400	1
225	-90.15769958	32.53746414	STRIBLING RD AND DEWEES, MADISON COUNTY, MS	STRIBLING RD / DEWEES CAN	28089030400	1
226	-90.04529572	32.60890961	W OTTO ST AND COWAN ST, MADISON COUNTY, MS	W OTTO ST / COWAN ST CAN	28089030500	1
227	-90.12355804	32.41132355	PEAR ORCHARD ROAD AND PEAR ORCHARD CIRCLE, MADISON COUNTY, MS	Pear Orchard Road/Pear Orchard Circle	28089030106	1
228	-89.76430511	32.68559647	HWY 16 EAST AND VIRGIN MARY RD, MADISON COUNTY, MS	HWY 16 EAST / VIRGIN MARY RD CAN	28089030900	1

COMPILED UNIQUE ROADBLOCKS:

Dr. Ricchetti's 1,697 CAD Roadblocks and 146 "Additional Roadblocks" from Incident Reports

	attributes_x	attributes_y	clean_address	original_address	geoid	number_of_r oadblocks
229	-90.31272125	32.5387001	FIRST ST AND ODOM ST, MADISON COUNTY, MS	FIRST ST / ODOM ST CAN	28089030302	1
230	-89.90139008	32.61052704	RATLIFF FERRY RD AND LONE PINE R, MADISON COUNTY, MS	RATLIFF FERRY RD / LONE PINE R CAN	28089030900	1
231	-90.31288147	32.54216385	FIRST ST AND MAIN ST, MADISON COUNTY, MS	FIRST ST / MAIN ST FLO	28089030302	1
232	-90.02425385	32.6227417	GARFIELD ST AND LINCOLN ST, MADISON COUNTY, MS	GARFIELD ST / LINCOLN ST CAN	28089030600	1
233	-90.14138031	32.51689148	GLUCKSTADT RD AND C STORE, MADISON COUNTY, MS	GLUCKSTADT RD / C STORE CAN	28089030301	1
234	-90.13147736	32.39951324	EAST COUNTY LINE ROAD AND MOSSLINE DRIVE, MADISON COUNTY, MS	East County Line Road / Mossline Drive	28089030106	1
235	-90.00817871	32.61122131	HWY 16 AND HWY 43, MADISON COUNTY, MS	HWY 16 / HWY 43 CAN	28089030600	1
236	-90.06335449	32.46813965	OLD RICE RD AND ASPEN DR, MADISON COUNTY, MS	OLD RICE RD / ASPEN DR CAN	28089030201	1
237	-90.11382294	32.41400146	711 LAKE HARBOUR DR, MADISON COUNTY, MS	711 LAKE HARBOUR DR RID	28089030106	1
238	-90.10623932	32.53151703	STRIBLING EXT AND CHURCH, MADISON COUNTY, MS	STRIBLING EXT / CHURCH CAN	28089030400	1
239	-90.31713104	32.58966446	HUNT AVE AND LIVINGSTON VERNON R, MADISON COUNTY, MS	HUNT AVE / LIVINGSTON VERNON R FLO	28089030302	1
240	-89.96974945	32.61860275	E HWY 16 AND ROBINSON RD, MADISON COUNTY, MS	E HWY 16 / ROBINSON RD CAN	28089030900	1
241	-89.75099945	32.76061249	HWY 43 AND MATLOCK RD, MADISON COUNTY, MS	HWY 43 / MATLOCK RD CAN	28089031000	1
242	-89.81078339	32.64796829	ROBINSON RD AND PAT LUCKETT RD, MADISON COUNTY, MS	ROBINSON RD / PAT LUCKETT RD CAN	28089030900	1
243	-90.17900085	32.47502518	N LIVINGSTON RD AND MCDONALD DR, MADISON COUNTY, MS	N LIVINGSTON RD / MCDONALD DR CAN	28089030302	1
244	-90.10637665	32.41625214	OLD CANTON RD AND MRA, MADISON COUNTY, MS	OLD CANTON RD / MRA MAD	28089030104	1
245	-90.05216217	32.62361526	1101 HOLMES AV, MADISON COUNTY, MS	1101 HOLMES AV CAN	28089030500	1
246	-90.10262299	32.40516281	875 WILLIAM BLVD, MADISON COUNTY, MS	875 WILLIAM BLVD RID	28089030108	1
247	-90.20373535	32.40357208	N LIVINGSTON RD AND MARY MYLES RD, MADISON COUNTY, MS	N LIVINGSTON RD / MARY MYLES RD RID	28089030206	1
248	-90.10137939	32.51712036	N. I-55 AND GLUCKSTADT ROAD, MADISON COUNTY, MS	N. I-55/Gluckstadt Road	28089030400	1
249	-90.05374146	32.61559296	112 SUNSET AVE, MADISON COUNTY, MS	112 SUNSET AVE CAN	28089030500	1
250	-90.00685883	32.67412186	HWY 51 AND PISGAH BOTTOM RD, MADISON COUNTY, MS	HWY 51 / PISGAH BOTTOM RD CAN	28089030900	1
251	-90.12696075	32.5234375	STILLHOUSE CREEK DR, MADISON COUNTY, MS	STILLHOUSE CREEK DR CAN	28089030400	1
252	-90.29964447	32.53530502	POCAHONTAS RD AND JEFFREYS RD, MADISON COUNTY, MS	POCAHONTAS RD / JEFFREYS RD FLO	28089030302	1
253	-90.08908081	32.56077576	OLD JACKSON RD AND RAGSDALE RD, MADISON COUNTY, MS	OLD JACKSON RD / RAGSDALE RD MAD	28089030400	1
254	-89.90813446	32.65834427	OLD HWY 16 AND CHURCH LN, MADISON COUNTY, MS	OLD HWY 16 / CHURCH LN CAN	28089030900	1
255	-90.02883148	32.51694489	YANDELL RD AND DEERFIELD BLVD, MADISON COUNTY, MS	YANDELL RD / DEERFIELD BLVD CAN	28089030400	1
256	-89.81421661	32.65003967	HHY 43 AND HWY 17, MADISON COUNTY, MS	HHY 43 / HWY 17 CAN	28089030900	1
257	-90.14666748	32.40386963	HWY 51 AND I-55, MADISON COUNTY, MS	HWY 51 / I-55 RID	28089030105	1
258	-90.10635376	32.42143631	OLD CANTON RD AND RICE RD, MADISON COUNTY, MS	OLD CANTON RD / RICE RD RID	28089030107	1
259	-90.19897461	32.42369843	N LIVINGSTON RD AND ROUSER RD, MADISON COUNTY, MS	N LIVINGSTON RD / ROUSER RD RID	28089030205	1
260	-90.05458832	32.6402626	GREEN ACRES AND KING RANCH, MADISON COUNTY, MS	GREEN ACRES / KING RANCH CAN	28089030500	1
261	-89.73869324	32.69438934	E HWY 16 AND PERMENTER RD, MADISON COUNTY, MS	E HWY 16 / PERMENTER RD CAN	28089030900	1
262	-90.00299072	32.61637878	COVINGTON DR AND HWY 43, MADISON COUNTY, MS	COVINGTON DR / HWY 43 CAN	28089030600	1
263	-90.03262329	32.63559341	W HWY 16 AND OIL MILL QUARTERS RD, MADISON COUNTY, MS	W HWY 16 / OIL MILL QUARTERS RD CAN	28089030600	1
264	-90.34346008	32.52296066	W HWY 22, MADISON COUNTY, MS	W HWY 22 CAN	28089030302	1
265	-90.03488922	32.61512756	HWY 51 AND N MAD, MADISON COUNTY, MS	HWY 51 / N MAD CAN	28089030600	1
266	-90.04753113	32.61672592	349 WELCH ST, MADISON COUNTY, MS	349 WELCH ST CAN	28089030500	1

COMPILED UNIQUE ROADBLOCKS:

Dr. Ricchetti's 1,697 CAD Roadblocks and 146 "Additional Roadblocks" from Incident Reports

	attributes_x	attributes_y	clean_address	original_address	geoid	number_of_r oadblocks
267	-90.18817139	32.51525497	HWY 463 AND REUNION BLVD, MADISON COUNTY, MS	HWY 463 / REUNION BLVD MAD	28089030301	1
268	-90.14444733	32.51688385	GLUCKSTADT RD AND KRISTEN HILL RD, MADISON COUNTY, MS	GLUCKSTADT RD / KRISTEN HILL RD CAN	28089030400	1
269	-90.05065155	32.61747742	390 RICKS DR, MADISON COUNTY, MS	390 RICKS DR CAN	28089030500	1
270	-89.93041992	32.78058243	LORING RD AND TUCKER RD, MADISON COUNTY, MS	LORING RD / TUCKER RD CAN	28089031000	1
271	-90.03502655	32.6380806	CMUANDRAILROAD, MADISON COUNTY, MS	CMU/RAILROAD CAN	28089030600	1
272	-90.16139984	32.4300766	OLD AGENCY RD AND DINSMOR CRSG, MADISON COUNTY, MS	OLD AGENCY RD / DINSMOR CRSG RID	28089030206	1
273	-90.08551025	32.51168823	HWY 51 AND YANDELL RD, MADISON COUNTY, MS	HWY 51 / YANDELL RD CAN	28089030400	1
274	-90.04384613	32.61013031	W ACADEMY ST AND S WALNUT ST, MADISON COUNTY, MS	W ACADEMY ST / S WALNUT ST CAN	28089030500	1
275	-90.30622101	32.5386734	POCAHONTAS RD AND WATSON ST, MADISON COUNTY, MS	POCAHONTAS RD / WATSON ST CAN	28089030302	1
276	-90.05490875	32.47240448	OLD RICE RD AND MADI, MADISON COUNTY, MS	OLD RICE RD / MADI CAN	28089030201	1
277	-90.01125336	32.74898529	WAY RD AND GRAY CENTER RD, MADISON COUNTY, MS	WAY RD / GRAY CENTER RD CAN	28089031000	1
278	-90.08907318	32.56425858	OLD JACKSON RD AND HILL RD, MADISON COUNTY, MS	OLD JACKSON RD / HILL RD CAN	28089030400	1
279	-90.04050446	32.60404968	TROLIO ST AND W DINKINS ST, MADISON COUNTY, MS	TROLIO ST / W DINKINS ST CAN	28089030700	1
280	-90.31697845	32.58352661	KEARNEY PARK RD AND MRS ST, MADISON COUNTY, MS	KEARNEY PARK RD / MRS ST CAN	28089030302	1
281	-90.21385956	32.46538544	LAKE CAVALIER ROAD AND SUNSET LANE, MADISON COUNTY, MS	Lake Cavalier Road / Sunset lane	28089030302	1
282	-90.04238892	32.60974121	S CANAL ST AND APPT COMPLEX, MADISON COUNTY, MS	S CANAL ST / APPT COMPLEX CAN	28089030500	1
283	-90.13632202	32.53750229	CATLETT RD AND STRIBLING RD, MADISON COUNTY, MS	CATLETT RD / STRIBLING RD CAN	28089030400	1
284	-90.26086426	32.49780273	ROBINSON SPRINGS RD AND ROBINSON, MADISON COUNTY, MS	ROBINSON SPRINGS RD / ROBINSON CAN	28089030302	1
285	-90.14391327	32.4360466	I-55 S AND RIDGELAND, MADISON COUNTY, MS	I-55 S / RIDGELAND CAN	28089030101	1
286	-90.04675293	32.61555862	BOYD ST, MADISON COUNTY, MS	Boyd St	28089030500	1
287	-90.0869751	32.41513824	BREAKERS LN, MADISON COUNTY, MS	BREAKERS LN CAN	28089030107	1
288	-90.04016113	32.49512863	TWELVE OAKS RD AND OLD CANTON RD, MADISON COUNTY, MS	TWELVE OAKS RD / OLD CANTON RD CAN	28089030201	1
289	-90.03968811	32.64033508	GREEN ACRES DR AND HWY 16W, MADISON COUNTY, MS	GREEN ACRES DR / HWY 16W CAN	28089030500	1
290	-90.13685608	32.54156876	TYLER LN AND CATLETT RD, MADISON COUNTY, MS	TYLER LN / CATLETT RD CAN	28089030400	1
291	-90.20355225	32.4080658	LIVINGSTON RD AND PEATRY PENDLETON, MADISON COUNTY, MS	LIVINGSTON RD / PEATRY PENDLETON RID	28089030206	1
292	-90.03132629	32.51693344	43 AND YANDELL RD, MADISON COUNTY, MS	43 / YANDELL RD CAN	28089030400	1
293	-90.05483246	32.6184845	KING RANCH RD AND GEORGE WASHINGTON AVE, MADISON COUNTY, MS	KING RANCH RD / GEORGE WASHINGTON AVE CAN	28089030500	1
294	-90.1555481	32.43022919	NATCHEZ TRACE AND GREENWOOD XING, MADISON COUNTY, MS	NATCHEZ TRACE / GREENWOOD XING RID	28089030206	1
295	-89.99462891	32.61118317	E HWY 16 AND COUNTRY CLUB DR, MADISON COUNTY, MS	E HWY 16 / COUNTRY CLUB DR CAN	28089030800	1
296	-89.93830109	32.7806282	LORING RD AND HARGON RD, MADISON COUNTY, MS	LORING RD / HARGON RD CAN	28089031000	1
297	-90.03336334	32.74444962	WAY RD AND WAY CIR, MADISON COUNTY, MS	WAY RD / WAY CIR CAN	28089031000	1
298	-90.10635376	32.43982315	RIDGECREST DR AND OLD CANTON RD, MADISON COUNTY, MS	RIDGECREST DR / OLD CANTON RD MAD	28089030101	1
299	-90.04935455	32.61853027	MACE STREET AND GEORGE WASHINGTON ST, MADISON COUNTY, MS	Mace Street / George Washington St	28089030500	1
300	-89.94203186	32.85522842	HWY 17 AND OLD 51 RD, MADISON COUNTY, MS	HWY 17 / OLD 51 RD PIC	28089031000	1
301	-90.11235046	32.4099884	NORTH PARK DR AND FONTAINE PL, MADISON COUNTY, MS	NORTH PARK DR / FONTAINE PL CAN	28089030106	1
302	-90.11093903	32.46031189	YANDELL AND MADISON CROSSING, MADISON COUNTY, MS	YANDELL / MADISON CROSSING CAN	28089030202	1
303	-90.14668274	32.53368759	SYCAMORE RIDGE AND ASHBROOKE BLV, MADISON COUNTY, MS	SYCAMORE RIDGE / ASHBROOKE BLV CAN	28089030400	1
304	-90.00198364	32.61001205	PEACE ST, MADISON COUNTY, MS	PEACE ST CAN	28089030600	1

COMPILED UNIQUE ROADBLOCKS:

Dr. Ricchetti's 1,697 CAD Roadblocks and 146 "Additional Roadblocks" from Incident Reports

	attributes_x	attributes_y	clean_address	original_address	geoid	number_of_r oadblocks
305	-90.33811188	32.55318069	COX FERRY RD AND OLD HWY 49, MADISON COUNTY, MS	COX FERRY RD / OLD HWY 49 FLO	28089030302	1
306	-90.0328598	32.63660812	HWY 16 AND OIL MILL QUARTERS RD, MADISON COUNTY, MS	HWY 16 / OIL MILL QUARTERS RD CAN	28089030600	1
307	-90.31289673	32.54469299	FIRST ST AND CENTER ST, MADISON COUNTY, MS	FIRST ST / CENTER ST FLO	28089030302	1
308	-89.99717712	32.58401108	1528 HWY 43, MADISON COUNTY, MS	1528 HWY 43 CAN	28089030900	1
309	-90.04543304	32.6113739	ROBY ST AND W FULTON ST, MADISON COUNTY, MS	ROBY ST / W FULTON ST CAN	28089030500	1
310	-90.09463501	32.5136528	WEISENBERGER ROAD AND PARKWAY EAST, MADISON COUNTY, MS	Weisenberger Road / Parkway East	28089030204	1
311	-90.04283142	32.60404968	W DINKINS ST AND RANGE, MADISON COUNTY, MS	W DINKINS ST / RANGE CAN	28089030700	1
312	-90.05379486	32.62360382	HOLMES AVENUE AND WAYNE DRIVE, MADISON COUNTY, MS	Holmes Avenue/Wayne Drive	28089030500	1
313	-90.02436829	32.6204834	MILLER ST AND LINCOLN ST, MADISON COUNTY, MS	MILLER ST / LINCOLN ST CAN	28089030600	1
314	-89.79151154	32.75230408	HWY 43 AND HONEYSUCKER RD, MADISON COUNTY, MS	HWY 43 / HONEYSUCKER RD CAN	28089031000	1
315	-90.11849976	32.46476364	MADISON PARKWAY AND POST OAK RD, MADISON COUNTY, MS	MADISON PARKWAY / POST OAK RD MAD	28089030203	1
316	-90.09156799	32.49990845	1556 HWY 51, MADISON COUNTY, MS	1556 HWY 51 MAD	28089030201	1
317	-90.05487823	32.47242355	OLD RICE RD AND CHANNEL LN, MADISON COUNTY, MS	OLD RICE RD / CHANNEL LN MAD	28089030201	1
318	-90.31023407	32.54489517	111 KEARNEY PARK RD, MADISON COUNTY, MS	111 KEARNEY PARK RD FLO	28089030302	1
319	-90.0558548	32.472332	OLD RICE AND HALEY CREEK, MADISON COUNTY, MS	OLD RICE / HALEY CREEK CAN	28089030201	1
320	-90.04888916	32.62274933	1006 HOLMES AV, MADISON COUNTY, MS	1006 HOLMES AV CAN	28089030500	1
321	-89.98647308	32.61324692	HWY 16 AND GREENFIELD DR, MADISON COUNTY, MS	HWY 16 / GREENFIELD DR CAN	28089030900	1
322	-90.10093689	32.48181152	HWY 51 AND TISDALE RD, MADISON COUNTY, MS	HWY 51 / TISDALE RD MAD	28089030203	1
323	-90.08110046	32.56065369	NISSAN AND I-55, MADISON COUNTY, MS	NISSAN / I-55 CAN	28089030400	1
324	-90.03939056	32.60658646	CAMERON ST AND LEE ST, MADISON COUNTY, MS	CAMERON ST / LEE ST CAN	28089030700	1
325	-90.09635162	32.42125702	RICE RD AND HARBOR DR, MADISON COUNTY, MS	RICE RD / HARBOR DR CAN	28089030107	1
326	-90.05480194	32.62392807	KING RANCH AND PARKVIEW, MADISON COUNTY, MS	KING RANCH / PARKVIEW CAN	28089030500	1
327	-90.07202148	32.46506119	HOY RD AND N OLD CANTON RD, MADISON COUNTY, MS	HOY RD / N OLD CANTON RD CAN	28089030201	1
328	-90.06373596	32.55365753	HIGHWAY 51 AND SOUTH LIBERTY, MADISON COUNTY, MS	Highway 51 / South Liberty	28089030400	1
329	-89.83846283	32.78039551	HWY 17 AND MCCARTY RD, MADISON COUNTY, MS	HWY 17 / MCCARTY RD CAM	28089031000	1
330	-90.32426453	32.5896759	LIVINGSTON VERNON AND ST CHARLE, MADISON COUNTY, MS	LIVINGSTON VERNON / ST CHARLE CAN	28089030302	1
331	-90.31217194	32.55142593	KEARNEY PARK RD AND COURT ST, MADISON COUNTY, MS	KEARNEY PARK RD / COURT ST FLO	28089030302	1
332	-90.04385376	32.61133957	WALNUT ST AND W FULTON ST, MADISON COUNTY, MS	WALNUT ST / W FULTON ST CAN	28089030500	1
333	-89.87865448	32.6220932	ROBINSON RD AND PLEASANT GIFT RD, MADISON COUNTY, MS	ROBINSON RD / PLEASANT GIFT RD CAN	28089030900	1
334	-90.11325073	32.457798	HWY 51 AND MADISON AVE, MADISON COUNTY, MS	HWY 51 / MADISON AVE CAN	28089030203	1
335	-90.10720825	32.46508026	HOY RD AND OLD CANTON RD, MADISON COUNTY, MS	HOY RD / OLD CANTON RD CAN	28089030202	1
336	-89.9355011	32.64578247	1400 SHARON RD, MADISON COUNTY, MS	1400 SHARON RD CAN	28089030900	1
337	-90.17773438	32.53680038	103 N I-55, MADISON COUNTY, MS	103 N I-55 RID	28089030400	1
338	-90.32935333	32.58968353	LIVINGSTON VERNON RD AND EMMIT R, MADISON COUNTY, MS	LIVINGSTON VERNON RD / EMMIT R CAN	28089030302	1
339	-89.98319244	32.65552902	GOODLOE RD . HWY 43, MADISON COUNTY, MS	GOODLOE RD . HWY 43 CAN	28089030900	1
340	-89.93563843	32.65857315	HWY 43 AND GOO, MADISON COUNTY, MS	HWY 43 / GOO CAN	28089030900	1
341	-90.1352005	32.5415535	TYLER LN AND CAT, MADISON COUNTY, MS	TYLER LN / CAT CAN	28089030400	1
342	-90.04441833	32.58664703	2941 HWY 51, MADISON COUNTY, MS	2941 HWY 51 CAN	28089030400	1

COMPILED UNIQUE ROADBLOCKS:

Dr. Ricchetti's 1,697 CAD Roadblocks and 146 "Additional Roadblocks" from Incident Reports

	attributes_x	attributes_y	clean_address	original_address	geoid	number_of_r oadblocks
343	-90.08921051	32.53160858	CHURCH RD AND OLD JACKSON RD, MADISON COUNTY, MS	CHURCH RD / OLD JACKSON RD CAN	28089030400	1
344	-90.01306152	32.51686478	YANDELL RD AND BAINBRIDGE CROSSI, MADISON COUNTY, MS	YANDELL RD / BAINBRIDGE CROSSI MAD	28089030900	1
345	-90.11871338	32.46292877	MAIN ST AND POST OAK RD, MADISON COUNTY, MS	MAIN ST / POST OAK RD CAN	28089030203	1
346	-90.09118652	32.52015686	N INDUSTRIAL BLVD, MADISON COUNTY, MS	N INDUSTRIAL BLVD CAN	28089030400	1
347	-90.10639954	32.42711639	OLD CANTON RD AND NATCHEZ TRACE, MADISON COUNTY, MS	OLD CANTON RD / NATCHEZ TRACE RID	28089030101	1
348	-90.31713867	32.58966446	KEARNEY PARK AND LIVINGSTON VERNON, MADISON COUNTY, MS	KEARNEY PARK / LIVINGSTON VERNON CAN	28089030302	1
349	-90.15924835	32.68291092	HWY 22 AND PANTHER CREEK, MADISON COUNTY, MS	HWY 22 / PANTHER CREEK CAN	28089030400	1
350	-90.08528137	32.68191147	WILLIAMS BLVD, MADISON COUNTY, MS	WILLIAMS BLVD CAN	28089030400	1
351	-90.22227478	32.49411392	ROBINSON SPRING RD AND COKER RD, MADISON COUNTY, MS	ROBINSON SPRING RD / COKER RD CAN	28089030302	1
352	-90.10136414	32.40216827	PINE KNOLL CT, MADISON COUNTY, MS	PINE KNOLL CT RID	28089030108	1
353	-90.01058197	32.61730576	COVINGTON DRIVE AND CISNE AVE, MADISON COUNTY, MS	Covington Drive / Cisne Ave	28089030600	1
354	-90.04670715	32.6129837	108 BOYD STREET, MADISON COUNTY, MS	108 Boyd Street	28089030500	1
355	-89.96806335	32.64184952	HWY 43 AND QUAIL RD, MADISON COUNTY, MS	HWY 43 / QUAIL RD CAN	28089030900	1
356	-90.0927887	32.49762344	HWY 51 AND GROSS RD, MADISON COUNTY, MS	HWY 51 / GROSS RD MAD	28089030204	1
357	-90.30010223	32.56463623	HARRIS RD AND HARRIS SUBDIVISION, MADISON COUNTY, MS	HARRIS RD / HARRIS SUBDIVISION FLO	28089030302	1
358	-90.07840729	32.60264587	HWY 22 AND VIRLILIA RD, MADISON COUNTY, MS	HWY 22 / VIRLILIA RD CAN	28089030400	1
359	-90.17762756	32.42744827	OLD AGENCY RD AND PATTERSON, MADISON COUNTY, MS	OLD AGENCY RD / PATTERSON CAN	28089030205	1
360	-89.93049622	32.65864182	OLD HWY 16 AND ROBERT DEARON RD, MADISON COUNTY, MS	OLD HWY 16 / ROBERT DEARON RD CAN	28089030900	1
361	-90.03488159	32.61856461	UNION ST AND LIBERTY ST, MADISON COUNTY, MS	UNION ST / LIBERTY ST CAN	28089030600	1
					TOTAL	1843

FID	attributes	attribut_1	clean_addr	original_a	geoid	number_of_r oadblocks	Point_nu mb
0	-90.17705536	32.4002533	W COUNTY LINE RD AND I-220, MADISON COUNTY, MS	W COUNTY LINE RD / I-220 RID	28089030206	114	1
1	-90.08860779	32.41168594	LOWER SPILLWAY RD, MADISON COUNTY, MS	LOWER SPILLWAY RD RID	28089030107	65	3
2	-90.10803986	32.40254593	OLD CANTON RD AND PINE KNOLL DR, MADISON COUNTY, MS	OLD CANTON RD / PINE KNOLL DR RID	28089030106	59	4
3	-90.03372955	32.64034653	W HWY 16 AND GREEN ACRES, MADISON COUNTY, MS	W HWY 16 / GREEN ACRES CAN	28089030600	38	8
4	-90.03488159	32.64033508	GREEN ACRES AND RAILROAD ST, MADISON COUNTY, MS	GREEN ACRES / RAILROAD ST CAN	28089030500	32	11
5	-89.9750061	32.52461243	HWY 43 AND NATCHEZ TRACE PKWY, MADISON COUNTY, MS	HWY 43 / NATCHEZ TRACE PKWY CAN	28089030201	25	14
6	-90.17292786	32.45587158	LAKE CASTLE RD AND RICHARDSON RD, MADISON COUNTY, MS	LAKE CASTLE RD / RICHARDSON RD CAN	28089030204	21	17
7	-90.09313965	32.41199875	HARBOR AND LAKE HARBOR, MADISON COUNTY, MS	HARBOR / LAKE HARBOR CAN	28089030107	20	18
8	-89.98714447	32.61305618	HWY 16 AND AVONDALE RD, MADISON COUNTY, MS	HWY 16 / AVONDALE RD CAN	28089030600	19	19
9	-90.10651398	32.40514755	OLD CANTON RD AND WILLIAM BLVD, MADISON COUNTY, MS	OLD CANTON RD / WILLIAM BLVD RID	28089030106	19	20
10	-90.10634613	32.41098785	HARBOUR PT XING AND OLD CANTON, MADISON COUNTY, MS	HARBOUR PT XING / OLD CANTON RID	28089030106	18	22
11	-90.13207245	32.4068222	TOWNE CENTER AND WHEATLEY, MADISON COUNTY, MS	TOWNE CENTER / WHEATLEY RID	28089030106	17	25
12	-90.19194031	32.52423477	HWY 463 AND GLUCKSTADT RD, MADISON COUNTY, MS	HWY 463 / GLUCKSTADT RD MAD	28089030301	12	33
13	-90.19989014	32.42080688	LIVINGSTON RD AND OLD AGENCY RD, MADISON COUNTY, MS	LIVINGSTON RD / OLD AGENCY RD CAN	28089030206	11	37
14	-90.17658997	32.40026093	I-220 AND W COUNTY LINE RD, MADISON COUNTY, MS	I-220 / W COUNTY LINE RD CAN	28089030206	11	39
15	-90.18656921	32.45495224	N LIVINGSTON RD AND LAKE CASTLE RD, MADISON COUNTY, MS	N LIVINGSTON RD / LAKE CASTLE RD MAD	28089030302	10	43
16	-89.97753906	32.52706146	HWY 43 AND YANDELL RD, MADISON COUNTY, MS	HWY 43 / YANDELL RD CAN	28089030201	9	49
17	-90.24606323	32.56061554	LIVINGSTON VERNON RD AND STOKES, MADISON COUNTY, MS	LIVINGSTON VERNON RD / STOKES CAN	28089030302	8	50
18	-89.99343109	32.51694489	YANDELL RD AND TWELVE OAKS TRACE, MADISON COUNTY, MS	YANDELL RD / TWELVE OAKS TRACE CAN	28089030201	8	51
19	-90.0888443	32.4116745	SPILLWAY RD AND BREAKERS LN, MADISON COUNTY, MS	SPILLWAY RD / BREAKERS LN RID	28089030108	8	53
20	-90.14375305	32.42818069	NATCHEZ TRACE PKWY AND I-55, MADISON COUNTY, MS	NATCHEZ TRACE PKWY / I-55 RID	28089030105	7	59
21	-90.20085907	32.44431686	LAKE CAVALIER RD AND N LIVINGSTON, MADISON COUNTY, MS	LAKE CAVALIER RD / N LIVINGSTON MAD	28089030302	7	64
22	-90.1235199	32.42500305	RICE RD AND PEAR ORCHARD RD, MADISON COUNTY, MS	RICE RD / PEAR ORCHARD RD RID	28089030104	6	67
23	-90.03852844	32.62369537	MARTIN LUTHER KING DR AND RAILROAD, MADISON COUNTY, MS	MARTIN LUTHER KING DR / RAILROAD CAN	28089030500	6	73
24	-90.10901642	32.41405106	LAKE HARBOUR DRIVE AND RANKIN, MADISON COUNTY, MS	Lake Harbour Drive / Rankin	28089030104	5	77
25	-90.15769196	32.51791	GLUCKSTADT RD AND DEWEES RD, MADISON COUNTY, MS	GLUCKSTADT RD / DEWEES RD CAN	28089030301	5	80
26	-89.8094635	32.7156105	HWY 17 AND SULPHUR SPRINGS RD, MADISON COUNTY, MS	HWY 17 / SULPHUR SPRINGS RD CAN	28089031000	5	85
27	-90.13199615	32.51691818	GLUCKSTADT RD AND CATLETT RD, MADISON COUNTY, MS	GLUCKSTADT RD / CATLETT RD CAN	28089030400	4	89
28	-90.07178497	32.51709747	YANDELL RD AND CLARKDELL RD, MADISON COUNTY, MS	YANDELL RD / CLARKDELL RD CAN	28089030400	4	98
29	-90.07054138	32.51710892	YANDELL RD AND MADISON CROSSING, MADISON COUNTY, MS	YANDELL RD / MADISON CROSSING MAD	28089030400	4	100
30	-90.18199921	32.40019989	W COUNTY LINE AND HIGHLAND COLONY, MADISON COUNTY, MS	W COUNTY LINE / HIGHLAND COLONY CAN	28089030206	4	101
31	-89.76596069	32.74020004	SULPHUR SPRING RD AND GIN RD, MADISON COUNTY, MS	SULPHUR SPRING RD / GIN RD CAN	28089030900	4	107
32	-90.09546661	32.49241257	HWY 51 AND GREEN OAK LN, MADISON COUNTY, MS	HWY 51 / GREEN OAK LN CAN	28089030204	4	108
33	-90.10624695	32.41098785	HARBOUR POINTE CROSSING AND NORT, MADISON COUNTY, MS	HARBOUR POINTE CROSSING / NORT RID	28089030108	4	110
34	-90.09117126	32.46505356	HOY RD AND RICE RD, MADISON COUNTY, MS	HOY RD / RICE RD MAD	28089030202	3	113
35	-90.01182556	32.63319778	FINNEY RD AND MORGAN RD, MADISON COUNTY, MS	FINNEY RD / MORGAN RD CAN	28089030600	3	115
36	-90.200737	32.4839325	ROBINSON SPRINGS RD AND POC, MADISON COUNTY, MS	ROBINSON SPRINGS RD / POC CAN	28089030302	3	118
37	-90.10951996	32.46508789	HWY 463 AND MADISON MIDDLE, MADISON COUNTY, MS	HWY 463 / MADISON MIDDLE CAN	28089030203	3	122
38	-89.96963501	32.52200317	HWY 43 AND TURCOTTE LAB DR, MADISON COUNTY, MS	HWY 43 / TURCOTTE LAB DR CAN	28089030900	3	124
39	-90.07056427	32.51711655	300 YANDELL RD, MADISON COUNTY, MS	300 YANDELL RD CAN	28089030400	3	127
40	-90.20282745	32.40014267	N LIVINGSTON RD AND COUNTY LINE, MADISON COUNTY, MS	N LIVINGSTON RD / COUNTY LINE CAN	28089030206	2	139
41	-90.12995911	32.42630768	HWY 51 AND NATCHEZ TRACE, MADISON COUNTY, MS	HWY 51 / NATCHEZ TRACE RID	28089030101	2	141
42	-90.072052	32.51708221	YANDELL RD AND BRACEY RD, MADISON COUNTY, MS	YANDELL RD / BRACEY RD CAN	28089030400	2	151
43	-90.19945526	32.42228317	N LIVINGSTON RD AND NATCHEZ TRACE BRIDGE, MADISON COUNTY, MS	N LIVINGSTON RD / NATCHEZ TRACE BRIDGE MAD	28089030206	2	154
44	-89.96032715	32.62166977	E HWY 16 AND ROYAL OAK RD, MADISON COUNTY, MS	E HWY 16 / ROYAL OAK RD CAN	28089030600	2	157

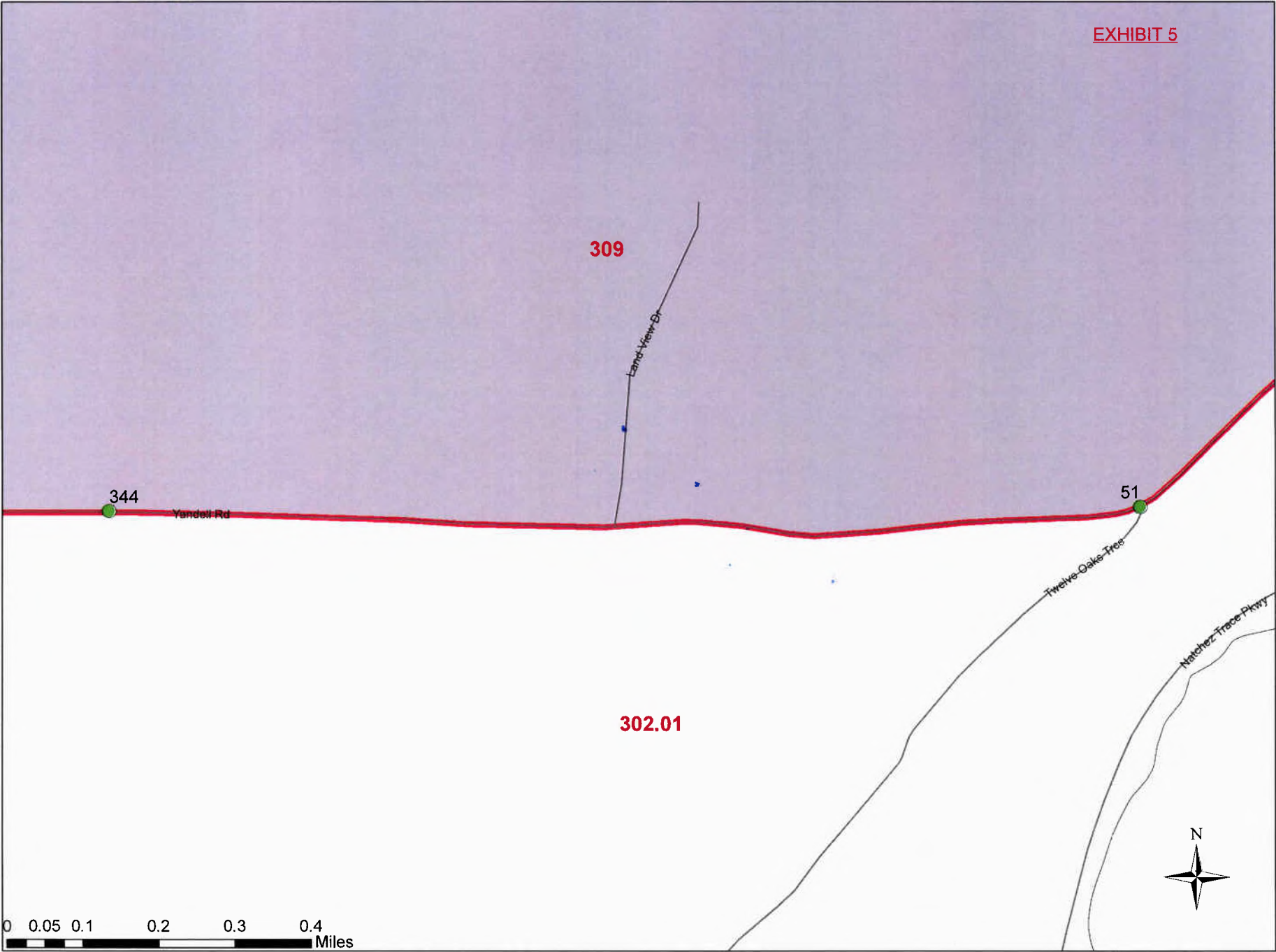
45	-90.029953	32.61016083	ACADEMY ST AND LYON ST, MADISON COUNTY, MS	ACADEMY ST / LYON ST CAN	28089030800	2	158
46	-90.07616425	32.51581192	YANDELL RD AND CLARKDELL RD EXT, MADISON COUNTY, MS	YANDELL RD / CLARKDELL RD EXT CAN	28089030400	2	161
47	-90.03491211	32.60403824	S LIBERTY ST AND W DINKINS ST, MADISON COUNTY, MS	S LIBERTY ST / W DINKINS ST CAN	28089030700	2	166
48	-90.13915253	32.49761581	BOZEMAN RD AND REUNION ANNANDALE, MADISON COUNTY, MS	BOZEMAN RD / REUNION ANNANDALE CAN	28089030301	2	177
49	-90.10643768	32.45043564	OLD CANTON RD AND ST AUGUSTINE D, MADISON COUNTY, MS	OLD CANTON RD / ST AUGUSTINE D MAD	28089030101	1	188
50	-90.19879913	32.43163681	N LIVINGSTON RD AND COU, MADISON COUNTY, MS	N LIVINGSTON RD / COU CAN	28089030302	1	189
51	-90.11701202	32.45050812	HWY 51 AND ST AUGUSTINE DR, MADISON COUNTY, MS	HWY 51 / ST AUGUSTINE DR MAD	28089030101	1	194
52	-90.16146851	32.51902771	463 AND GLUCKSTADT RD, MADISON COUNTY, MS	463 / GLUCKSTADT RD CAN	28089030301	1	196
53	-89.97251129	32.52275848	HWY 43 AND BROWNS LANDING RD, MADISON COUNTY, MS	HWY 43 / BROWNS LANDING RD CAN	28089030201	1	203
54	-90.05475616	32.63266754	HEINDL RD AND KING RANCH RD, MADISON COUNTY, MS	HEINDL RD / KING RANCH RD CAN	28089030500	1	211
55	-90.14138031	32.51689148	GLUCKSTADT RD AND C STORE, MADISON COUNTY, MS	GLUCKSTADT RD / C STORE CAN	28089030301	1	233
56	-90.13147736	32.39951324	EAST COUNTY LINE ROAD AND MOSSLINE DRIVE, MADISON COUNTY, MS	East County Line Road / Mossline Drive	28089030106	1	234
57	-90.00817871	32.61122131	HWY 16 AND HWY 43, MADISON COUNTY, MS	HWY 16 / HWY 43 CAN	28089030600	1	235
58	-90.11382294	32.41400146	711 LAKE HARBOUR DR, MADISON COUNTY, MS	711 LAKE HARBOUR DR RID	28089030106	1	237
59	-89.96974945	32.61860275	E HWY 16 AND ROBINSON RD, MADISON COUNTY, MS	E HWY 16 / ROBINSON RD CAN	28089030900	1	240
60	-90.17900085	32.47502518	N LIVINGSTON RD AND MCDONALD DR, MADISON COUNTY, MS	N LIVINGSTON RD / MCDONALD DR CAN	28089030302	1	243
61	-90.10637665	32.41625214	OLD CANTON RD AND MRA, MADISON COUNTY, MS	OLD CANTON RD / MRA MAD	28089030104	1	244
62	-90.10262299	32.40516281	875 WILLIAM BLVD, MADISON COUNTY, MS	875 WILLIAM BLVD RID	28089030108	1	246
63	-90.10137939	32.51712036	N. I-55 AND GLUCKSTADT ROAD, MADISON COUNTY, MS	N. I-55/Gluckstadt Road	28089030400	1	248
64	-90.02883148	32.51694489	YANDELL RD AND DEERFIELD BLVD, MADISON COUNTY, MS	YANDELL RD / DEERFIELD BLVD CAN	28089030400	1	255
65	-90.10635376	32.42143631	OLD CANTON RD AND RICE RD, MADISON COUNTY, MS	OLD CANTON RD / RICE RD RID	28089030107	1	258
66	-90.19897461	32.42369843	N LIVINGSTON RD AND ROUSER RD, MADISON COUNTY, MS	N LIVINGSTON RD / ROUSER RD RID	28089030205	1	259
67	-90.05458832	32.6402626	GREEN ACRES AND KING RANCH, MADISON COUNTY, MS	GREEN ACRES / KING RANCH CAN	28089030500	1	260
68	-90.14444733	32.51688385	GLUCKSTADT RD AND KRISTEN HILL RD, MADISON COUNTY, MS	GLUCKSTADT RD / KRISTEN HILL RD CAN	28089030400	1	268
69	-90.08551025	32.51168823	HWY 51 AND YANDELL RD, MADISON COUNTY, MS	HWY 51 / YANDELL RD CAN	28089030400	1	273
70	-90.14391327	32.4360466	I-55 S AND RIDGELAND, MADISON COUNTY, MS	I-55 S / RIDGELAND CAN	28089030101	1	285
71	-90.03968811	32.64033508	GREEN ACRES DR AND HWY 16W, MADISON COUNTY, MS	GREEN ACRES DR / HWY 16W CAN	28089030500	1	289
72	-90.03132629	32.51693344	43 AND YANDELL RD, MADISON COUNTY, MS	43 / YANDELL RD CAN	28089030400	1	292
73	-90.00198364	32.61001205	PEACE ST, MADISON COUNTY, MS	PEACE ST CAN	28089030600	1	304
74	-90.09156799	32.49990845	1556 HWY 51, MADISON COUNTY, MS	1556 HWY 51 MAD	28089030201	1	316
75	-89.98647308	32.61324692	HWY 16 AND GREENFIELD DR, MADISON COUNTY, MS	HWY 16 / GREENFIELD DR CAN	28089030900	1	321
76	-90.10093689	32.48181152	HWY 51 AND TISDALE RD, MADISON COUNTY, MS	HWY 51 / TISDALE RD MAD	28089030203	1	322
77	-90.11325073	32.4577798	HWY 51 AND MADISON AVE, MADISON COUNTY, MS	HWY 51 / MADISON AVE CAN	28089030203	1	334
78	-90.01306152	32.51686478	YANDELL RD AND BAINBRIDGE CROSSI, MADISON COUNTY, MS	YANDELL RD / BAINBRIDGE CROSSI MAD	28089030900	1	344
79	-90.10639954	32.42711639	OLD CANTON RD AND NATCHEZ TRACE, MADISON COUNTY, MS	OLD CANTON RD / NATCHEZ TRACE RID	28089030101	1	347
80	-90.0927887	32.49762344	HWY 51 AND GROSS RD, MADISON COUNTY, MS	HWY 51 / GROSS RD MAD	28089030204	1	356
81	-90.17762756	32.42744827	OLD AGENCY RD AND PATTERSON, MADISON COUNTY, MS	OLD AGENCY RD / PATTERSON CAN	28089030205	1	359



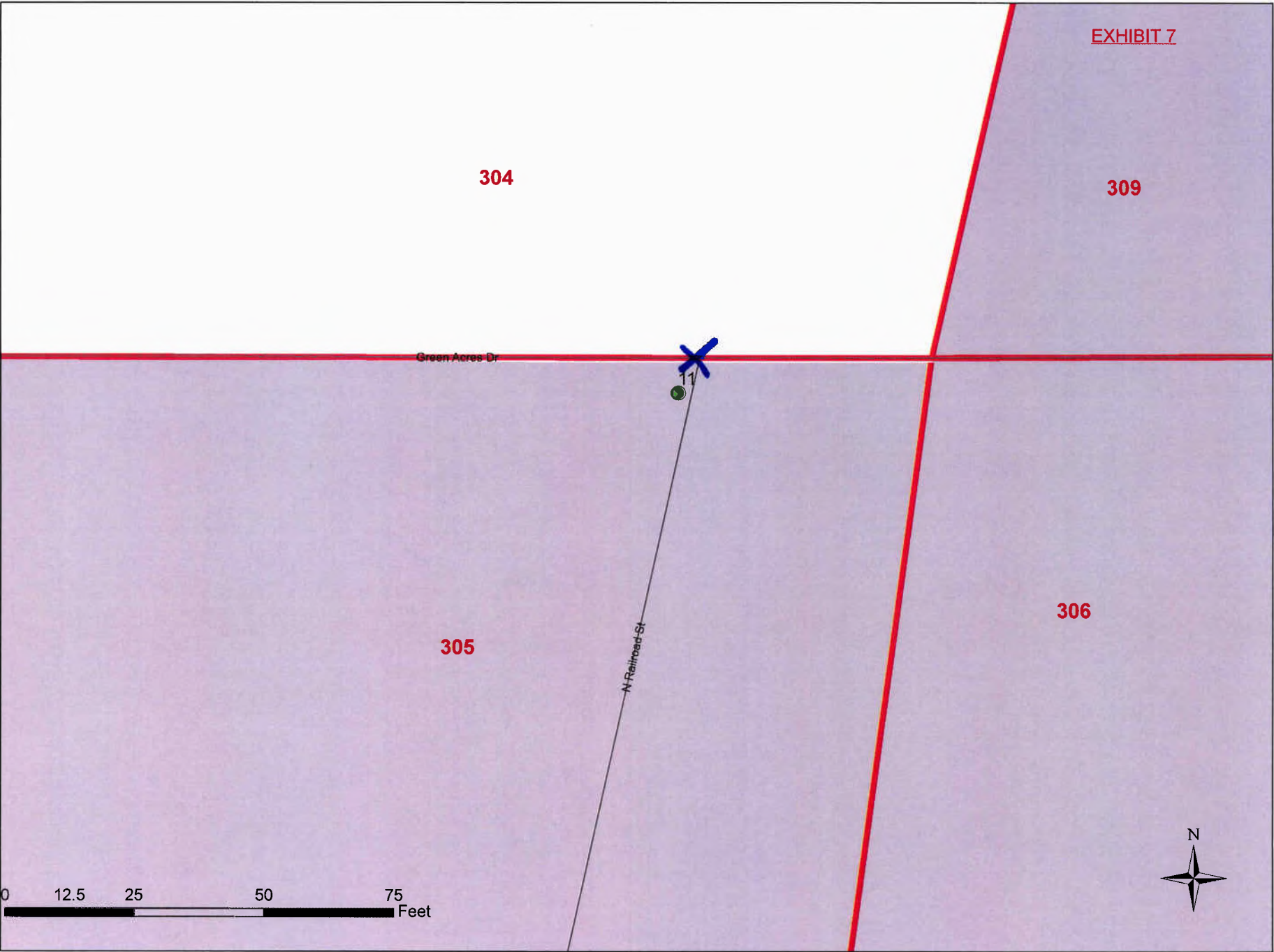




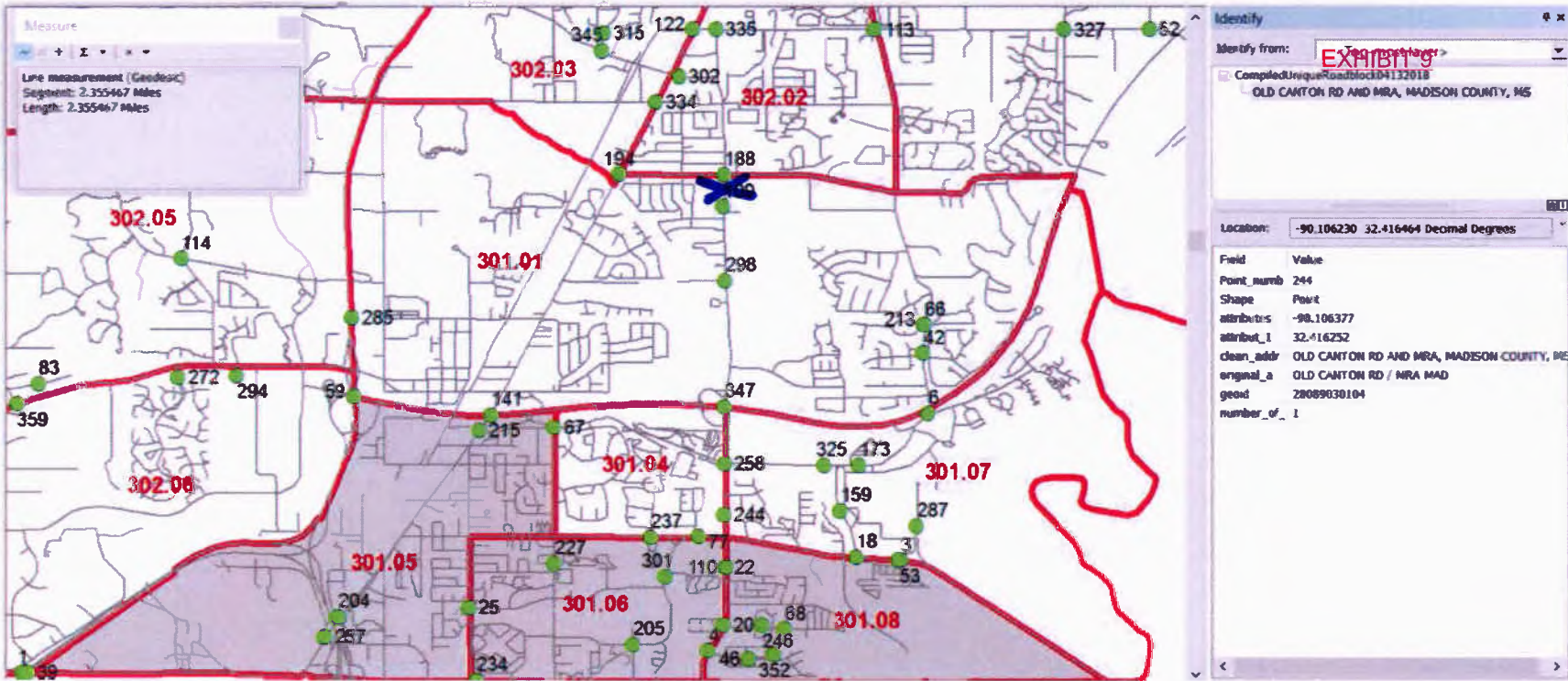


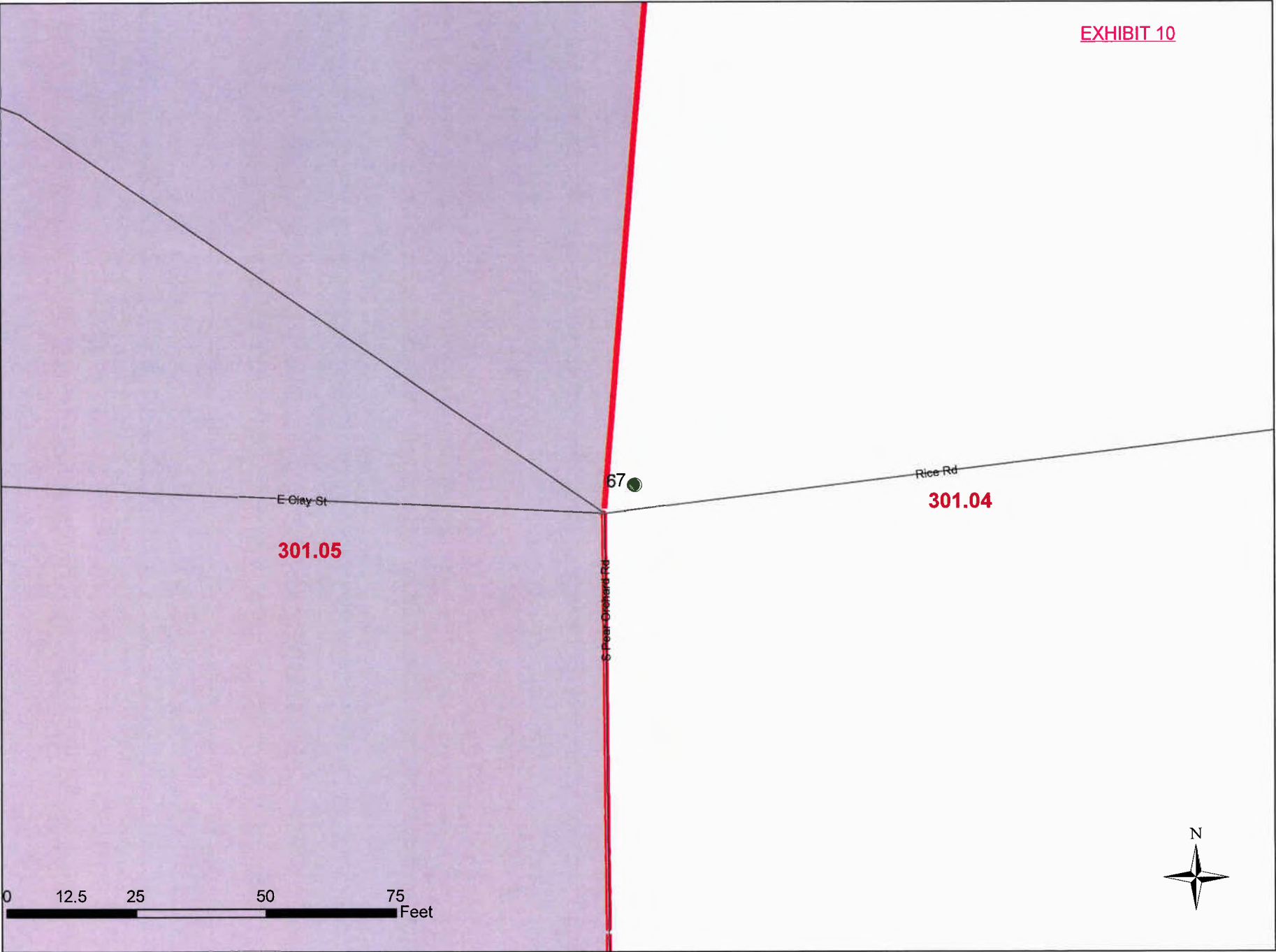


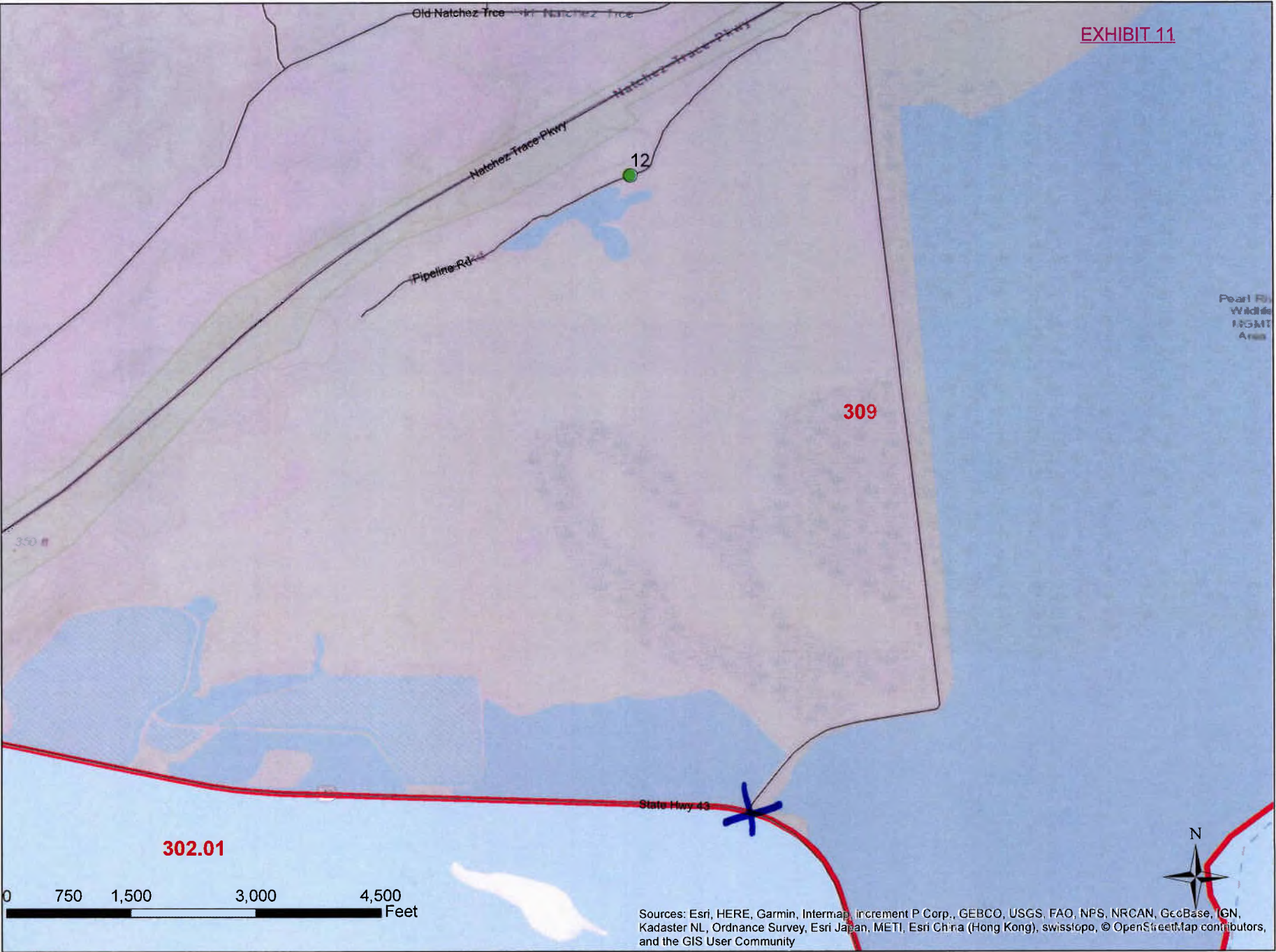






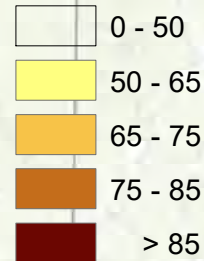




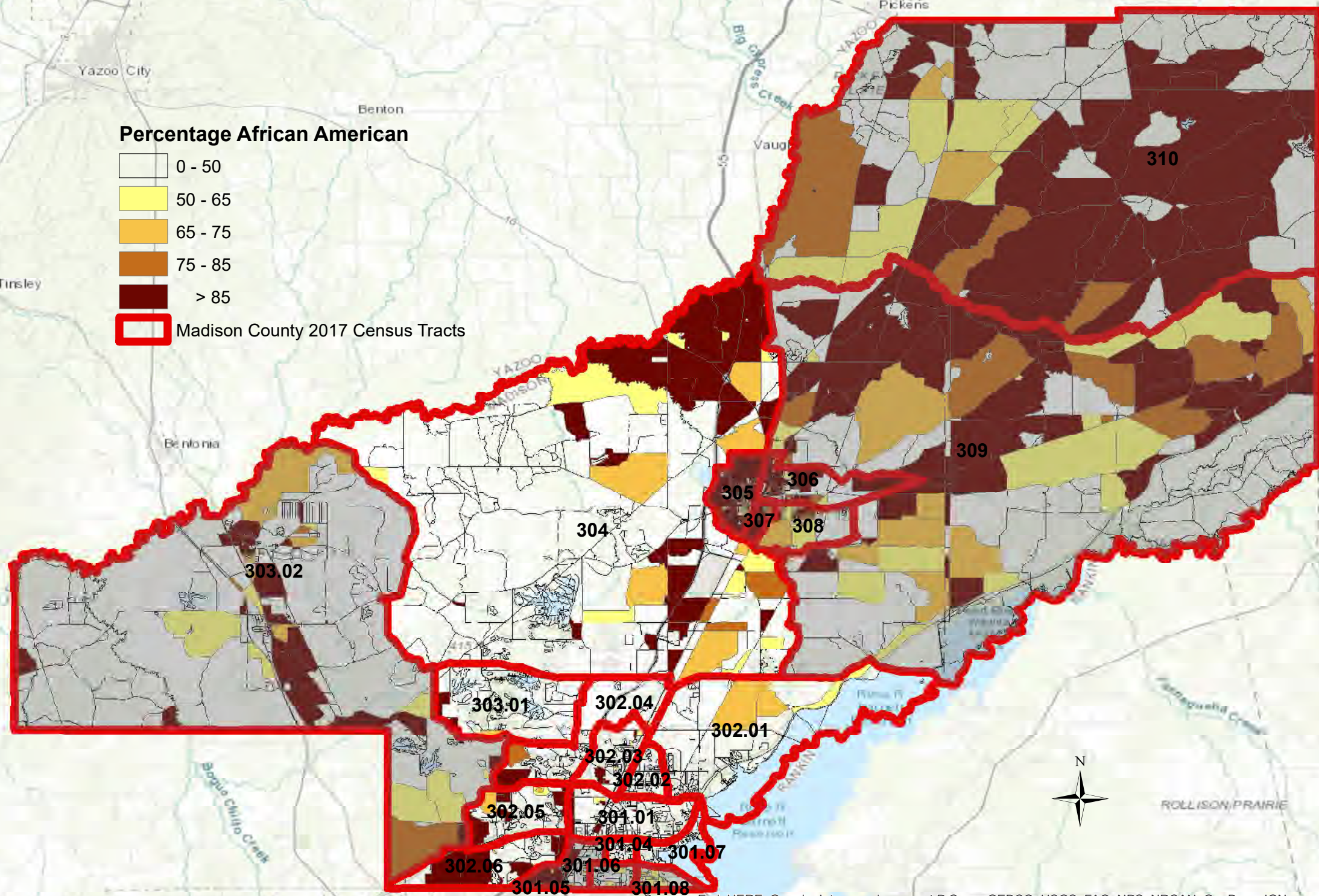


Madison County 2010 Census Blocks and "Predominantly" Black Census Tracts

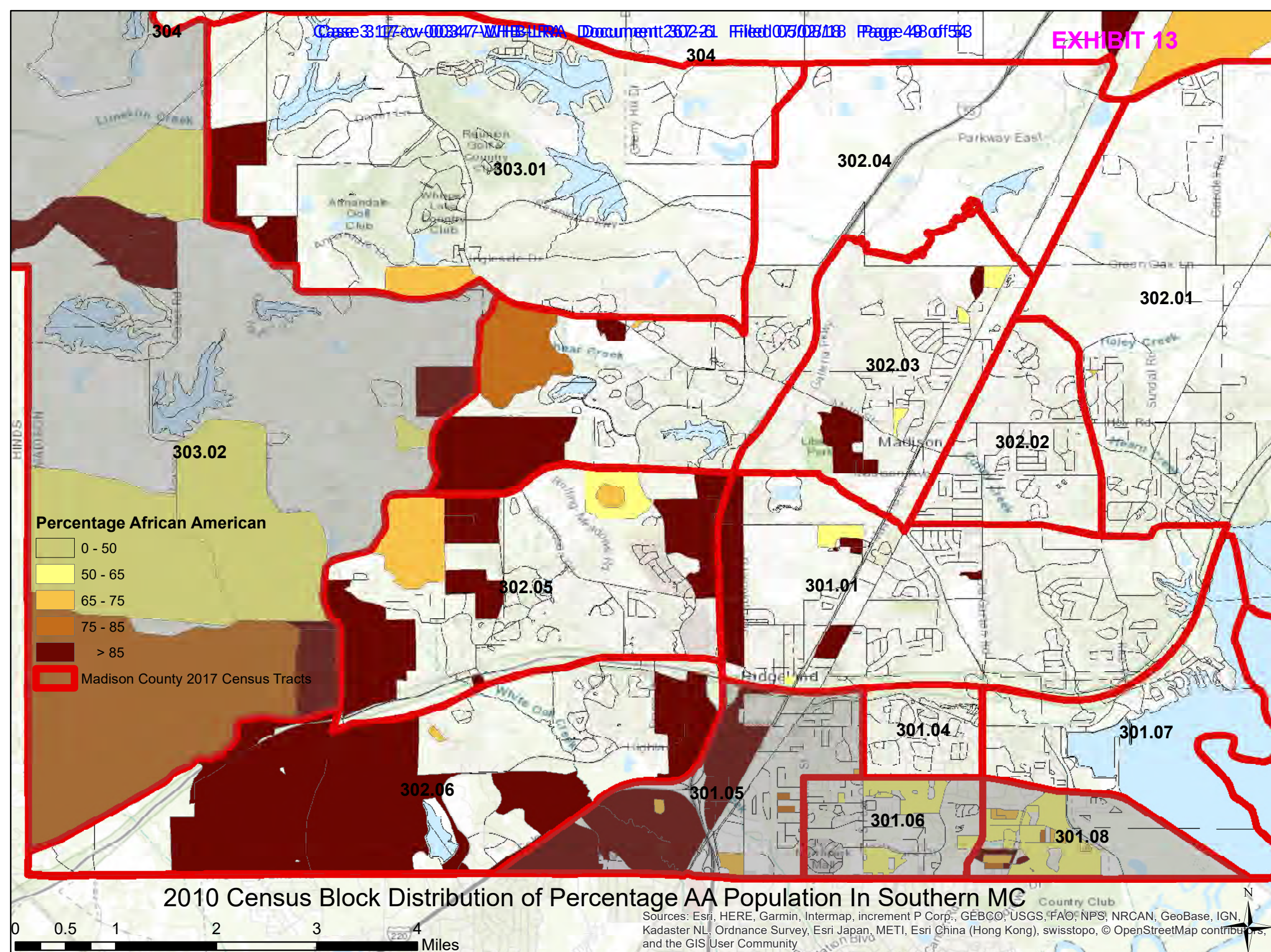
Percentage African American

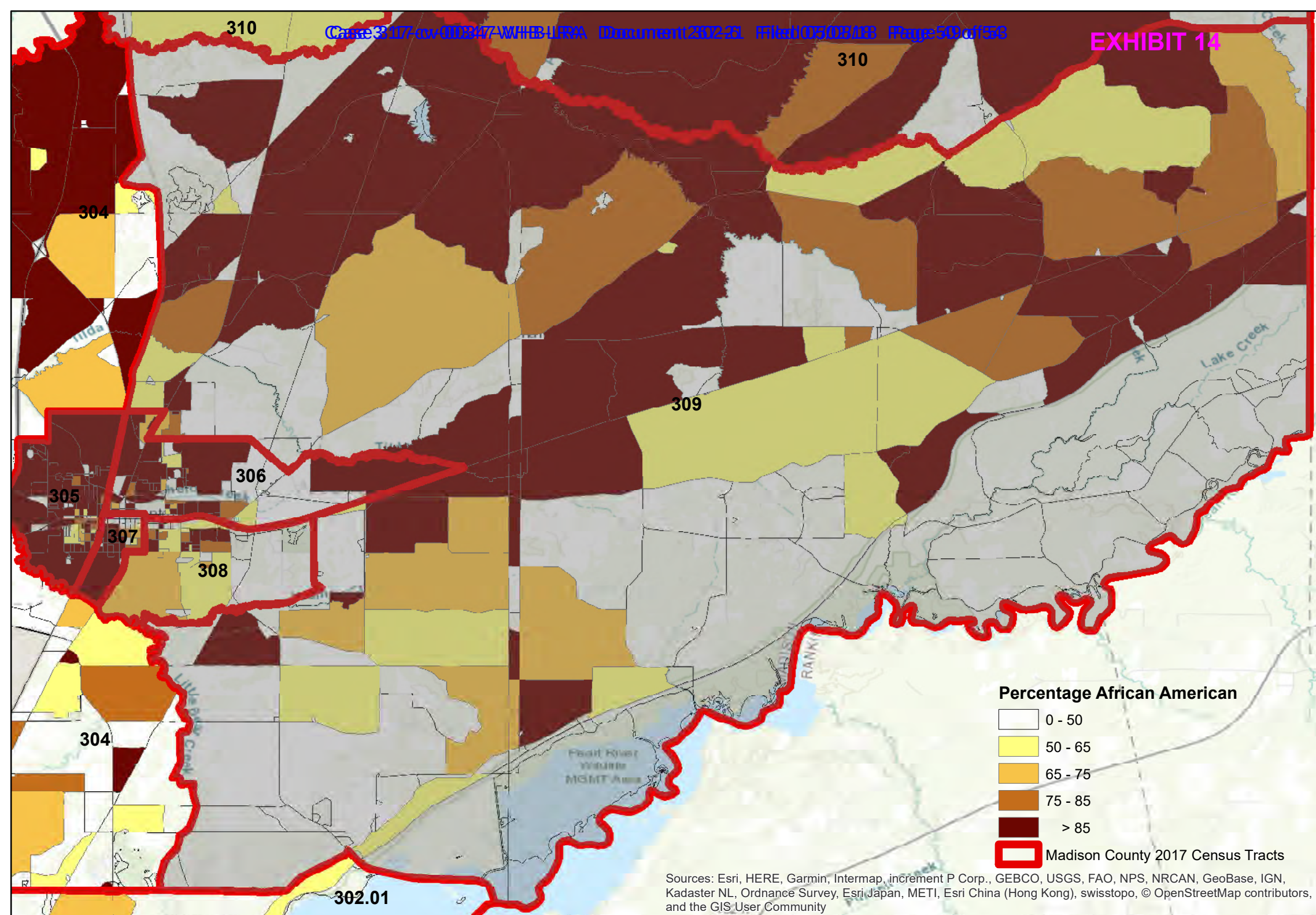


Madison County 2017 Census Tracts



ROLLISON PRAIRIE



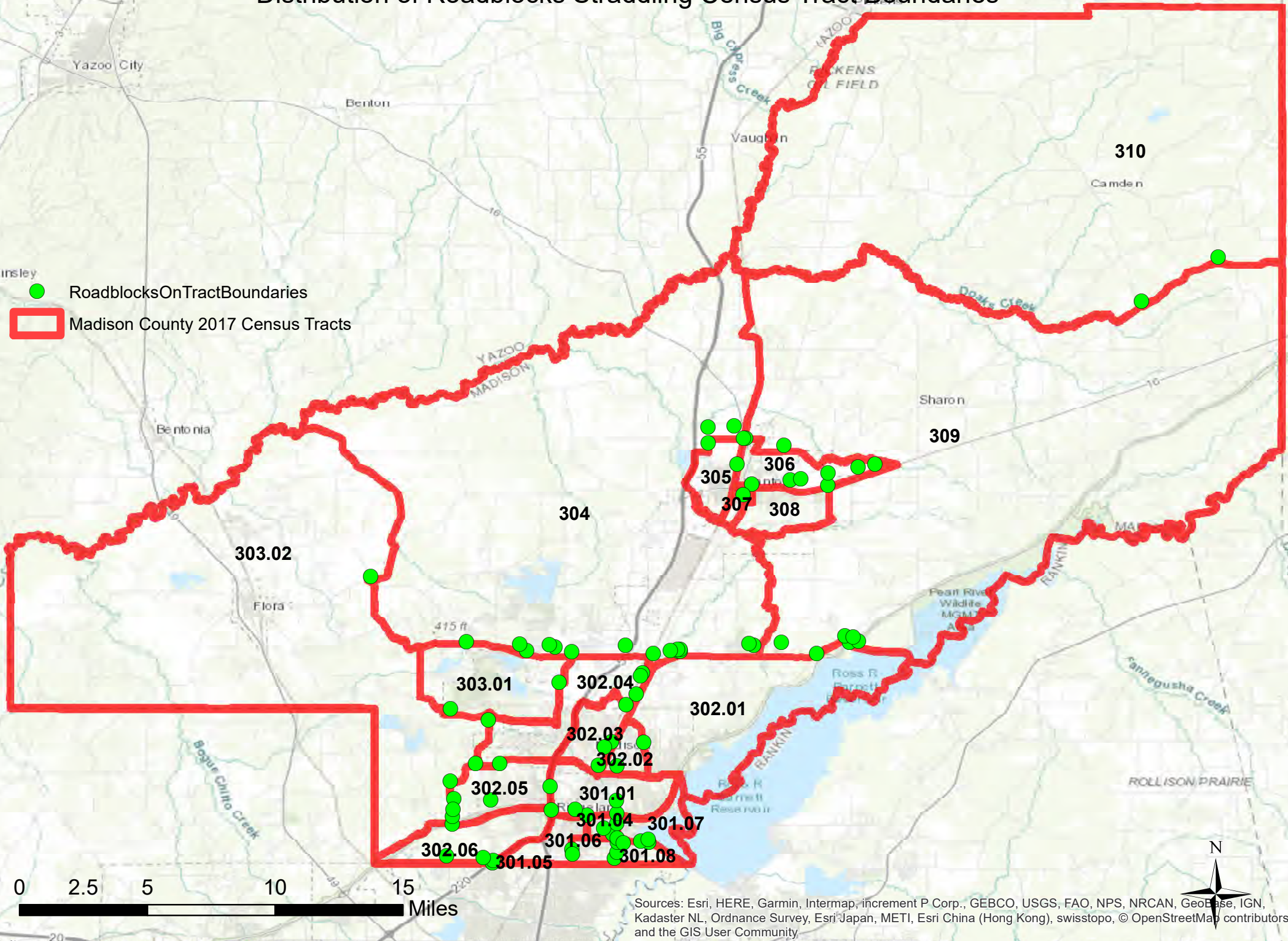


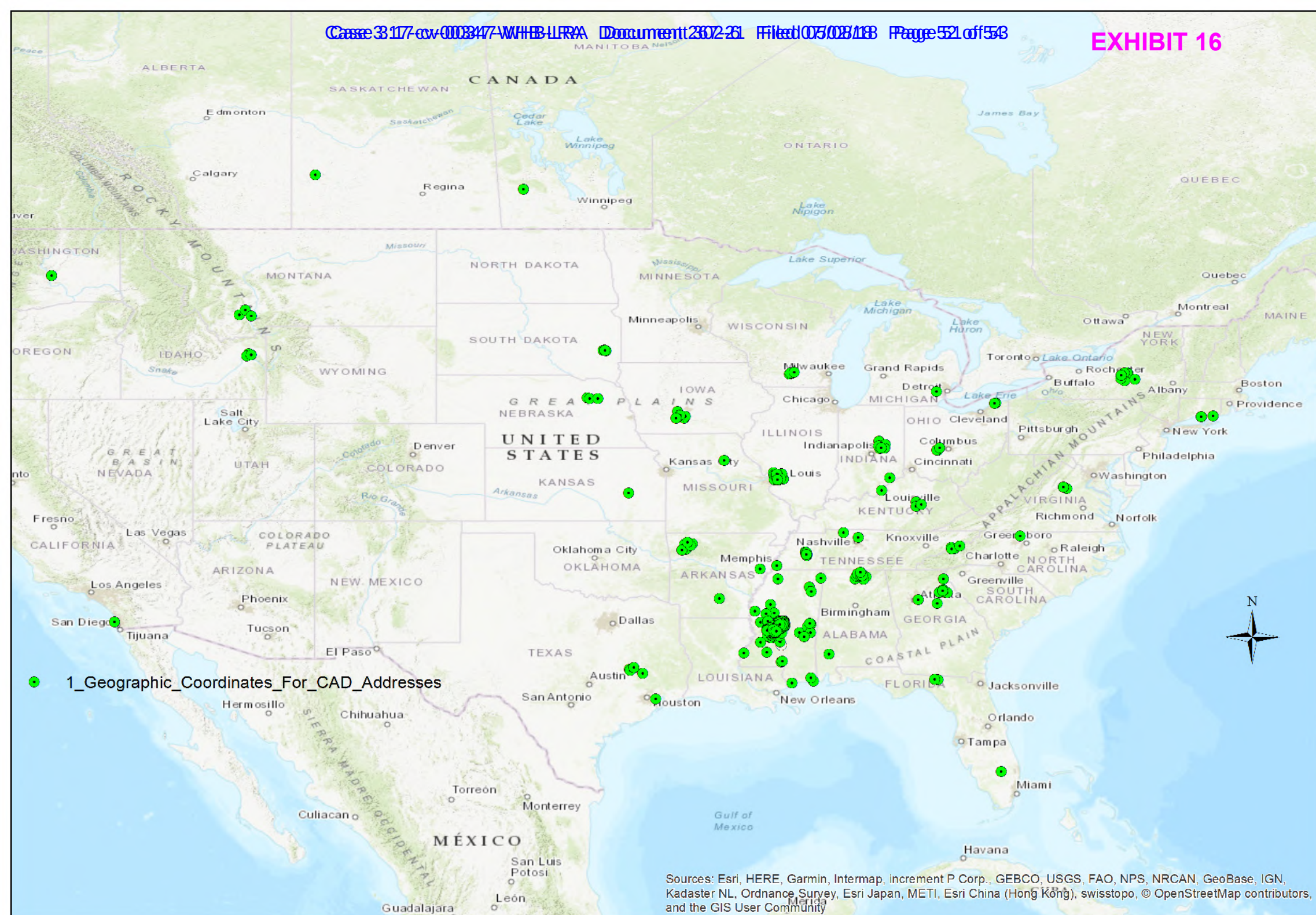
2010 Census Block Distribution of Percentage African American Population In Tract 309

0 0.75 1.5 3 4.5 6 Miles



- RoadblocksOnTractBoundaries
▭ Madison County 2017 Census Tracts

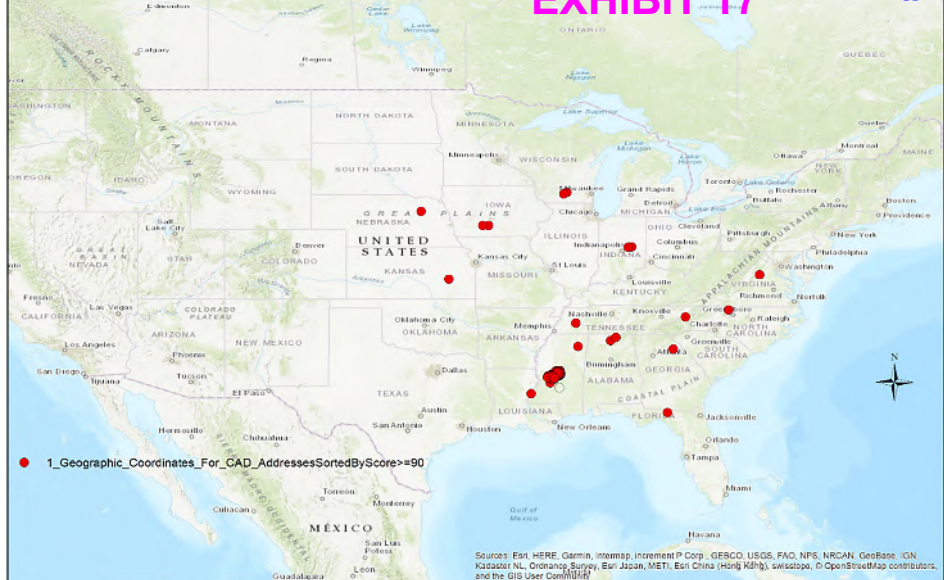




Nationwide Distribution of Geocoded CAD Addresses

0 150 300 600 900 1,200
Miles

EXHIBIT 17



Nationwide Distribution of Geocoded CAD Addresses With Score Greater Than or Equal to 90

0 150 300 600 900 1,200 Miles

**IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
JACKSON DIVISION**

LATOYA BROWN, et al.

PLAINTIFFS

v.

CIVIL ACTION NO. 3:17-cv-347 WHB LRA

MADISON COUNTY, MISSISSIPPI; et al.

DEFENDANTS

DECLARATION OF WILLIAM R. FUNDERBURK

I, William R. Funderburk, make the following declaration based on personal knowledge:

1. I have been retained by the Defendants in the above referenced matter as expert. I submit that the foregoing report from me dated May 8, 2018 is a true and accurate copy of the report I provided to Defendants in this matter. I declare that the information and opinions contained in the report are true and correct to the best of my knowledge.

I declare under penalty of perjury that the foregoing is true and correct. 28 U.S.C. § 1746.

May 8, 2018

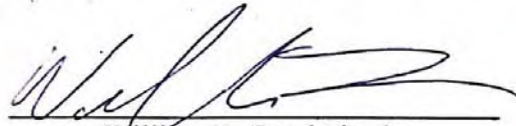

William R. Funderburk

EXHIBIT 7

BRYAN RICCHETTI, PH.D., 4/6/2018

Page 1

IN THE UNITED STATES DISTRICT COURT
FOR THE SOUTHERN DISTRICT OF MISSISSIPPI
JACKSON DIVISION

LATOYA BROWN; LAWRENCE)	
BLACKMON; HERBERT ANTHONY)	
GREEN; KHADAFY MANNING;)	
QUINETTA MANNING; MARVIN)	
MCFIELD, NICHOLAS SINGLETON;)	
STEVEN SMITH; BESSIE THOMAS;)	
and BETTY JEAN WILLIAMS)	
TUCKER, individually and on)	
behalf of a class of all)	
other similarly situated,)	
)	
Plaintiffs,)	
)	Civil Action No.
-vs-)	3:17-cv-347 WHB LRA
)	
MADISON COUNTY, MISSISSIPPI;)	
SHERIFF RANDALL S. TUCKER,)	
in his official capacity;)	
and MADISON COUNTY SHERIFF'S)	
DEPUTIES JOHN DOES #1)	
through #6, in their)	
individual capacities,)	
)	
Defendants.)	

The deposition of BRYAN RICCHETTI, Ph.D.,
taken before JUNE M. FUNKHOUSER, CSR, RMR, and
Notary Public, pursuant to the Federal Rules of
Civil Procedure for the United States District
Courts pertaining to the taking of depositions, at
181 West Madison Street, 43rd Floor, Chicago,
Illinois, commencing at 9:11 a.m. on April 6, 2018.

1 Sometimes there's addresses.

2 Q Most of them were hard street numbered
3 addresses that you could mail something to?

4 A Well, the way we -- the way it works is
5 we have this software called ArcGIS which is --

6 Q I'm very familiar with it.

7 A Yeah. And so that you can merge those on
8 and get an estimated address.

9 Q The problem with ArcGIS, help me out if
10 I'm right here, it needs specific information to
11 give you a geocode?

12 A So it has a match score, it will tell you
13 how -- you know, whether it can match a specific
14 location.

15 Q So if ArcGIS was to plant or geocode a
16 roadblock location based on an intersection
17 description, just say Interstate 220 and County
18 Line Road, it would put that geocode square in the
19 middle of the intersection because that's the
20 center line of the two roads, correct?

21 MR. YOUNGWOOD: Objection; form.

22 THE WITNESS: It's possible that in some
23 of those situations you would be in a road.

24 BY MR. NOBILE:

25 Q Who did the geocoding for your analysis?

1 A So, you know, my team working under my
2 supervision used this software, ArcGIS, which
3 ultimately gave us these locations.

4 Q How did you verify the accuracy of these
5 locations?

6 A Well, ArcGIS has this match score, and so
7 to the extent it gets a hundred that means it's a
8 perfect match according to ArcGIS and then once it
9 falls below 90 we don't include those records in my
10 analysis.

11 Q But the perfect match on a street
12 intersection between two intersections or two
13 streets would be in the middle of the intersection?

14 A It would be assigned to a census tract
15 some way.

16 Q How do you make that assignment? Who
17 verified that assignment? Because if you're doing
18 a roadblock in the middle of County Line Road one
19 half is in one census tract, the other one is in
20 the other census tract. How did you account for
21 any of that?

22 MR. YOUNGWOOD: Objection; form.

23 THE WITNESS: So for the -- where we have
24 an exact address it accounts for it and to the
25 extent the address is imprecise we're removing the

1 driving behavior are direct measures of driving
2 behavior, again, the DUIs and the traffic citations
3 we have from the CAD data.

4 Q All right. I'm going to turn to page x
5 of the foreword.

6 The -- it says here at the beginning
7 of the first full paragraph at the top of the page,
8 it says -- I'll let you get there.

9 A Sure.

10 Q And, again, this is I guess an authority
11 you cited in your report. If that's not accurate
12 let me know.

13 A Yeah, I cite to it for just a general
14 discussion of some methodological issues.

15 Q "The question of whether bias influences
16 some officers when they stop drivers, like many
17 other social science research questions in criminal
18 justice and related fields, is impossible to answer
19 with complete certainty," do you agree with that?

20 MR. YOUNGWOOD: Objection to form.

21 THE WITNESS: Yeah, I would say in my
22 analysis, again, talk about this causation issue,
23 what I'm ultimately measuring is this average
24 difference in outcomes controlling for other
25 factors. I'm not measuring intentional -- any

1 measure of bias directly. It's these average
2 differences controlling for other factors.

3 BY MR. NOBILE:

4 Q Okay. So you're not making a finding of
5 causation then. You're not saying they're making
6 racial determinations. You're just saying the
7 disparity in outcomes.

8 A I do not have data on anyone's intentions
9 or -- but what I can do is look at factors that I
10 understand are considered when setting up
11 roadblocks and see if, you know, again, are there
12 more roadblocks in certain areas given, say, the
13 level of DUIs, et cetera, so I can kind of rule out
14 that those are explanations.

15 Q Okay. On page 17 of this report, and
16 I'll let you turn to it, the very top of the page,
17 first partial paragraph.

18 A Uh-huh.

19 Q Midway through it says: "Additionally,
20 nonresidents will drive into the target
21 jurisdiction (the jurisdiction that is the subject
22 of the police-citizen contact data analysis) to
23 shop, seek entertainment, vacation, travel on to
24 another jurisdiction, and for other reasons." You
25 agree with that?

1 there some extra frequency of roadblocks associated
2 with areas that happen to have more
3 African-Americans.

4 Q But that's based on residents, not on
5 African-Americans on the road?

6 A Yeah, but the question is -- the
7 residents are the ones impacted by the roadblocks,
8 as you discussed earlier, so the question is if you
9 happen to be in a more African-American
10 neighborhood in terms of the residency are there
11 going to be more roadblocks, is there some extra
12 number of roadblocks that might be happening.

13 Q Are you saying, and these are fundamental
14 questions to this case so I have to ask you this,
15 are you saying that the officers that make the
16 decisions or are you prepared to say that the
17 officers that make the decisions about the
18 placement of roadblocks are doing so for racist
19 purposes?

20 MR. YOUNGWOOD: Objection to form.

21 THE WITNESS: My analysis does not
22 address that.

23 BY MR. NOBILE:

24 Q And is anything in your report saying
25 that you found an official policy of targeting or

23 The undersigned is not interested in the
24 within case, nor of kin or counsel to any of the
25 parties.

1 Witness my official signature and seal as
2 Notary Public in and for Kane County, Illinois, on
3 the _____ day of _____, A.D. _____.

4

5

6

JUNE M. FUNKHOUSER, CSR, RMR
Notary Public
License No. 084-003024
311 South Wacker Drive
Suite 300
Chicago, Illinois 60606
(312) 386-2000

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3 LATOYA BROWN; LAWRENCE)
BLACKMON; HERBERT ANTHONY)
4 GREEN; KHADAFY MANNING;)
QUINETTA MANNING; MARVIN)
5 MCFIELD, NICHOLAS SINGLETON;)
STEVEN SMITH; BESSIE THOMAS;)
6 and BETTY JEAN WILLIAMS)
TUCKER, individually and on)
7 behalf of a class of all)
other similarly situated,)
8)
Plaintiffs,)
9) Civil Action No.
-vs-) 3:17-cv-347 WHB LRA
10)
MADISON COUNTY, MISSISSIPPI,)
11 et al.)
Defendants.)

13 I hereby certify that I have read the
14 foregoing transcript of my deposition given at the
15 time and place aforesaid, consisting of Pages 1 to
16 235 inclusive, and I do again subscribe and make
17 oath that the same is a true, correct, and complete
18 transcript of my deposition so given as aforesaid,
19 and includes changes, if any, so made by me.

BRYAN RICCHETTI, Ph.D.

22 SUBSCRIBED AND SWORN TO before me this
23 _____ day of _____, 2018.

24

25 Notary Public AT-170048

EXHIBIT 8

D. STEWARD
UNITED STATES DISTRICT COURT

FOR THE SOUTHERN DISTRICT OF MISSISSIPPI

NORTHERN DIVISION

LATOYA BROWN; LAWRENCE BLACKMON;
HERBERT ANTHONY GREEN;
KHADAFY MANNING; QUINNETTA MANNING;
MARVIN McFIELD; NICHOLAS SINGLETON;
STEVEN SMITH; BESSIE THOMAS; and
BETTY JEAN WILLIAMS TUCKER,
individually and on behalf of a
class of all others similarly
situated,

Plaintiffs,

Civil Action No.

vs.

3:17-CV-00347-WHB-LRA

MADISON COUNTY, MISSISSIPPI;
SHERIFF RANDALL S. TUCKER, in his
official capacity; and MADISON
COUNTY SHERIFF'S DEPUTIES JOHN
DOES #1 THROUGH #6, in their
individual capacities,

Defendants.

DEPOSITION OF DWIGHT STEWARD, PhD

Jackson, Mississippi

Friday, June 22, 2018

Reported by: DEBRA AMOS ISBELL, CCR,RDR,CRR

Job No: 143371

1 D. STEWARD

2 Q. And does this list all the expert witness
3 testimony that you've done in terms of your expert
4 work?

5 MR. NOBILE: Objection. Form.

6 A. Yes.

7 Q. And I know earlier we talked about -- so in
8 addition to your February 2018 testimony, after that
9 date it sounds like you also testified earlier this
10 week; correct?

11 A. Yes.

12 Q. Beyond the testimony that you gave earlier
13 this week, have you had any other expert witness
14 testimony between what's listed on your CV here and
15 the testimony this week?

16 A. Yes.

17 Q. What else was that testimony?

18 A. I don't recall all of the -- I'd say it's
19 probably eight or nine since this date. On Friday of
20 last week there was a case in California, EEOC case.
21 And then prior to that there was trial testimony,
22 about the week before that. And then there was some
23 other -- I don't recall the other ones. There was
24 maybe a month in between. Like maybe four or five
25 other ones since February.

1 D. STEWARD

2 then you're going to want to understand the factors.

3 And so the grants, how that works. You're going to

4 want to understand everything about the process.

5 That's what you would do first. It's not so much a

6 matter of which tool you use and which variables you

7 stick into it. And also you have to have correct data

8 as well. I should also mention that.

9 Q. And you mentioned factors. So is it correct
10 that the factors shown to be associated with DUI
11 activity would be something that you would want to
12 account for in that kind of analysis?

13 A. Again, this has to be general because I'm
14 saying specifically the first step is you've got to
15 get data that's correct. That's the very first thing.
16 You have to understand the data first and you have to
17 have data where, for example, the roadblocks are
18 actually placed. You'd have to know where they are
19 and have reliable information.

20 Then after that you'd have to understand the
21 processes and then understand, you know, kind of
22 what's going on in those areas that you're looking at
23 if you were doing that analysis. But again, I'm not
24 doing that analysis at this point.

25 Q. And you're saying that your role here, you

1 D. STEWARD

2 saw it as being a rebuttal to what Dr. Ricchetti's
3 work was as opposed to doing your own kind of
4 independent, affirmative analysis of kind of the data
5 here in this case?

6 MR. NOBILE: Objection. Form,
7 mischaracterization. You can answer.

8 A. The best I can do is just try to explain
9 what my role -- like I said before, obviously my
10 first -- one of my roles is a rebuttal expert. That's
11 the title of the report. And then I looked at the
12 information. But at this point I haven't been asked
13 to do a separate analysis.

14 Q. So Dr. Steward, we're going to turn to
15 paragraph 13 of Exhibit 1, if you want to flip back a
16 few pages. And I think the page number at the top
17 should be page 7, if that's helpful. And in looking
18 at paragraph 13, you have a statement -- are you at
19 13?

20 A. Yes, ma'am.

21 Q. I didn't want to get ahead of you if you
22 needed more time. There you say that:

23 "Dr. Ricchetti compounds the
24 flaws in his analysis by
25 accounting for irrelevant

1 D. STEWARD

2 phone conversations with Mr. Funderburk about either
3 of your engagements in this case or your work in this
4 case?

5 A. No, I don't recall one, no.

6 Q. And beyond what you've read in
7 Mr. Funderburk's report, which I think you said you
8 reviewed as part of your deposition preparation for
9 today, you didn't do any sort of further analysis or
10 tests of what Mr. Funderburk did in terms of his
11 report in this case; is that correct?

12 A. That's correct.

13 Q. And in looking at the geocoding methodology
14 here, do you feel that you're qualified to provide an
15 expert opinion on Dr. Ricchetti's geocoding
16 methodology in this case?

17 A. Yes, ma'am, to the extent that I've
18 discussed here. Because I'm not talking about his
19 methodology. I'm saying something is wrong. And that
20 I'm qualified to say. Because you have to have right
21 data to do what he does. So step 1 is the data is
22 incorrect. See, I'm very qualified to say that
23 because, again, I'm looking at these issues that are
24 incorrect, and then I show you the actual economic
25 impact of that. So yes, ma'am, that's well inside my

1 D. STEWARD

2 shows that number that could be replicated of the 600
3 over 2,000 that you just mentioned here?

4 A. Well, the number -- I understand
5 Mr. Funderburk has a number similar in his report.
6 But again, I'm just describing what I've shown in the
7 data. But I believe Mr. Funderburk finds about 600 or
8 so observations that would straddle a census tract.
9 And that's what I'm referring to as well.

10 Q. So when you're saying that there are 600
11 observations out of 2,000 that would straddle a census
12 tract, is that information coming solely from your
13 review of Mr. Funderburk's report?

14 MR. NOBILE: Objection. Form.

15 A. No.

16 Q. So did you do some sort of independent
17 analysis where you also identified that there were
18 approximately 600 observations that have this issue?

19 A. Yes.

20 Q. And again, where is that analysis in your
21 report regarding 600 observations having this issue?

22 A. It's not in my report. I provided all the
23 backup documents to my actual analysis. If you run
24 those files, you'll be able to see just what I'm
25 describing.

1 D. STEWARD

2 Q. But to be clear, it's not in your written
3 report, though, not in your report here?

4 MR. NOBILE: Objection. Form,
5 mischaracterization.

6 A. It's in my analysis. And in my report I
7 provided all that information. I don't have a
8 discussion of that number, but it's in the files that
9 I provided to you guys.

10 Q. And in terms of this geocoding testing that
11 you did, how did you decide to do these tests here
12 described in paragraph 28 to, I think, 31, what we've
13 been talking about?

14 A. Yes. I decided when -- again, as I said
15 before, the first step in any of these types of
16 analyses is to look at the fundamental data. And in
17 this case the fundamental data is the roadblocks. And
18 so my first thing I wanted to look at was how
19 Dr. Ricchetti was looking at the roadblocks, how he
20 was placing it into the census tracts. Because that's
21 his fundamental analysis.

22 Q. And is this analysis something that
23 defendants or defendants' counsel asked you to
24 perform?

25 A. No.

1 D. STEWARD

2 Q. And in terms of saying that it should be
3 reasonable to expect that there's likely a
4 relationship here, can you point to any literature,
5 any sort of sources that you reviewed, that support
6 that there should be a correlation between these
7 aspects?

8 MR. NOBILE: Objection.

9 A. All I can say right now is it exists. I
10 can't identify them as I sit here. You just would
11 need to look at the demographics of the particular
12 event that you're looking at. You could look at
13 traffic surveys in particular. These are things that
14 Dr. Ricchetti could look at. But as I sit here, I
15 don't have a report to point him to to fix that
16 particular issue.

17 Q. And did you look at any of those types of
18 sources that you just mentioned in preparing your
19 rebuttal report here?

20 A. No. Those are pretty standard. No, ma'am,
21 I didn't.

22 Q. And so I'm just going to -- taking a look at
23 paragraph -- actually, sorry. Strike that.

24 In terms of -- I think you mentioned in
25 terms of recreational boating areas, you look to see

1 D. STEWARD

2 there are these areas, and I also show that those are
3 important areas to consider in any analysis.

4 Q. And just to confirm, but you didn't actually
5 go and try to figure out where a bar -- I'm sorry --
6 where boating and recreational areas were in relation
7 to roadblocks from the data that you were looking at?

8 MR. NOBILE: Objection.

9 Mischaracterization, form. You can answer.

10 A. Again, as I was saying before, I didn't
11 perform an analysis in this case. What I'm saying is
12 I did look at that through Dr. Ricchetti's analysis.
13 I didn't do a separate analysis. I looked at
14 Dr. Ricchetti's analysis and where he put the
15 roadblocks and where they were in relationship to
16 bars. I didn't do anything separate in this analysis.

17 Q. In just looking at paragraph 51 of your
18 report, Dr. Steward, so in that paragraph -- and I'll
19 give you a second to turn to it. I think it's the
20 next page actually, paragraph 51.

21 A. Okay.

22 Q. So there you give this example of the
23 Ridgeland census tract, which I believe is 301.07 that
24 you have here in your report. And you mention in your
25 report that there were 163 roadblocks shown in

1 D. STEWARD

2 A. That was done in a similar fashion. Again,
3 I looked at Dr. Ricchetti's data, which had the
4 location of the roadblock. It also had the time of
5 the roadblock. And so I just did a simple tabulation
6 of how many of the roadblocks in Dr. Ricchetti's data
7 were established between 7 p.m. and 3 a.m.

8 Q. Okay. So you based it on the time
9 information that was included for each roadblock in
10 the dataset that you were looking at?

11 A. Yes.

12 Q. And in looking back -- in looking at bar and
13 boat areas -- and we can use, I guess, the code that
14 we were just looking at as an example -- you looked at
15 that at a census tract level; correct?

16 A. I didn't look at it at any level. Keep in
17 mind I'm not doing a separate analysis. I'm looking
18 at what Dr. Ricchetti did. Dr. Ricchetti looked at
19 this at a census tract level.

20 Q. But it would be fair to say that the code
21 that we're just looking at, which I believe is
22 Exhibit 6, that was performed based on census tract
23 301.07; correct?

24 A. That was based on census tract 301.07 that
25 was in Dr. Ricchetti's data.

1 D. STEWARD

2 MR. NOBILE: No questions from us.

3 (THE DEPOSITION OF DWIGHT STEWARD, PhD

4 WAS CONCLUDED AT 4:17 P.M.)

5
6
7 _____
8 DWIGHT STEWARD, PhD
9

10 Subscribed and sworn to before me
11 this _____ day of _____ 2018.
12

13 _____
14 (Notary Public)

_____ My Commission Expires:
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D. STEWARD
C E R T I F I C A T E

I do hereby certify that the foregoing proceedings were taken down by me and transcribed using computer-aided transcription and that the foregoing is a true and correct transcript of said proceedings.

I further certify that I am neither of counsel nor of kin to any of the parties, nor am I in anywise interested in the result of said cause.

I further certify that I have earned the certifications awarded by the National Court Reporters Association of RPR,RMR,RDR,CRR,CRC,RSA and am duly licensed by the Alabama, Illinois, Louisiana and Mississippi Boards of Court Reporting as a Certified Court Reporter.

Dated: June 25, 2018

DEBRA AMOS ISBELL, CCR,RDR,CRR
ALABAMA - ACCR #21 (expires 9/30/18)
ILLINOIS - CSR #084.004798 (expires 5/31/19)
LOUISIANA - CCR #2014003 (expires 12/31/18)
MISSISSIPPI - CSR #1809 (expires 4/10/19)
NCRA (expires 12/31/2018)

EXHIBIT 9

1 W. Funderburk
2 UNITED STATES DISTRICT COURT

3 FOR THE SOUTHERN DISTRICT OF MISSISSIPPI

4 NORTHERN DIVISION
5 -----

6 LATOYA BROWN; LAWRENCE BLACKMON;
7 HERBERT ANTHONY GREEN;
8 KHADAFY MANNING; QUINNETTA MANNING;
9 MARVIN McFIELD; NICHOLAS SINGLETON;
10 STEVEN SMITH; BESSIE THOMAS; and
11 BETTY JEAN WILLIAMS TUCKER,
12 individually and on behalf of a
13 class of all others similarly
14 situated,

15 Plaintiffs,

16 Civil Action No.

17 vs.

18 3:17-CV-00347-WHB-LRA

19 MADISON COUNTY, MISSISSIPPI;
20 SHERIFF RANDALL S. TUCKER, in his
21 official capacity; and MADISON
22 COUNTY SHERIFF'S DEPUTIES JOHN
23 DOES #1 THROUGH #6, in their
24 individual capacities,

25 Defendants.
26 -----

27 DEPOSITION OF WILLIAM FUNDERBURK

28 Gulfport, Mississippi

29 Wednesday, June 20, 2018

30 Reported by: DEBRA AMOS ISBELL, CCR,RDR,CRR

31 Job No: 143370

1 W. Funderburk

2 governments?

3 A. I do oftentimes provide guidance and
4 assistance to local municipalities in the development
5 of their geographic information systems of their
6 localities. I also am in charge of developing
7 external relationships and seeking external funding
8 for experiments to be performed such as remote sensing
9 experiments, as listed in my CV.

10 Q. Have you ever worked with or worked for a
11 law enforcement agency before this matter?

12 A. No, sir.

13 Q. You have military experience, but you don't
14 have law enforcement experience; is that correct?

15 A. Correct.

16 Q. Do you have any expertise in statistics?

17 A. I would say yes.

18 Q. What is that?

19 A. I've used various statistics and statistical
20 analyses in the scientific peer-review publications
21 that I have put out as well as taken graduate-level
22 statistics courses as well as undergraduate-level
23 statistics courses.

24 Q. Are you familiar with the concept classical
25 measurement error?

1 W. Funderburk

2 A. Not off the top of my head.

3 Q. Could you describe the work you did to
4 prepare your report?

5 A. That's a pretty open-ended question. Can
6 you be a little more specific, please?

7 Q. It looks like from your report that you
8 spoke to at least one of the sheriff's deputies for
9 Madison County named Rylon Thompson; is that correct?

10 A. That is correct; yes, sir.

11 Q. Did you speak to any other Madison County
12 Sheriff's Department personnel?

13 A. No, I did not.

14 Q. Did you review any written materials
15 prepared by Madison County Sheriff's Department
16 personnel?

17 A. I did. I reviewed Mr. Sandridge's -- Mark
18 Sandridge's -- I don't remember if he's a deputy or
19 officer -- Mark Sandridge's report.

20 MR. NOBILE: Declaration for him.

21 Q. And other than -- I think it's Lieutenant
22 Sandridge. Other than Lieutenant Sandridge's
23 report -- sorry -- other than Lieutenant Sandridge's
24 declaration, did you review any other written
25 materials prepared by any other sheriff's department

1 W. Funderburk

2 Q. It says that this exhibit you're on,
3 Exhibit 1, already shows several roadblock locations
4 near the reservoir. Could you identify those
5 locations on the exhibit?

6 MR. NOBILE: I'll just object. The exhibit
7 speaks for itself. And to the extent that he can,
8 given the degradation of the image in the printing.

9 A. So the image depicts point number 18 and
10 point number 159 as well as point number 287, as
11 listed in my report. It also depicts several other
12 positions that are not listed in the paragraph. They
13 are listed later on in the report.

14 Q. And there's -- there's an X marked on the
15 page; is that right?

16 A. Yes, there is. That X depicts where the
17 roadblock locations actually occurred versus the
18 geocoded locations by Dr. Ricchetti that are
19 incorrect.

20 Q. And who marked that X?

21 A. Deputy Thompson.

22 Q. And so the basis for your statement that
23 that's where the roadblocks actually occurred, that's
24 where Deputy Thompson identified them as having
25 occurred?

1 W. Funderburk

2 A. Yes.

3 Q. You state then in 48, sub (a): "MCSD does
4 not conduct roadblocks on Breakers Lane."

5 Do you see that?

6 A. I do.

7 Q. What's your basis for that statement?

8 A. Deputy Thompson, ground truth validation,
9 which is completely reliable in this case.

10 Q. And what's your basis for saying that it's
11 reliable?

12 A. He had boots on the ground. He was there.
13 He helped set up these roadblocks. And my
14 understanding is that these roadblocks occur in the
15 same places every year or however frequent they set
16 up.

17 Q. What's the basis for your understanding that
18 they occur in the same places every year?

19 MR. NOBILE: Objection. Characterization.

20 A. Via Lieutenant Sandridge's report as well as
21 the testimony of Deputy Thompson.

22 Q. So when you say "testimony," are you
23 referring to interview?

24 A. Yeah. Sorry. I apologize for the misuse of
25 terminology.

1 W. Funderburk

2 geocoding process that Dr. Ricchetti performed split
3 those roadblocks into two different areas. And now,
4 they're not representative of one roadblock either.
5 These are multiple roadblocks at this one location
6 that have been split, it appears to be, across two
7 different areas.

8 Let me look at point 18 real quick.

9 So in this case -- in this example point 18
10 falls out in census tract 301.07 as well as point 159.
11 But that doesn't necessarily mean that that's going to
12 be uniform across the entire dataset.

13 Q. Did you use a particular methodology in
14 identifying this subset of geocoded data points that
15 were going to be the subject of your analysis?

16 A. Pretty much randomly navigated to these
17 points. You know, I hate to use the word "randomly
18 chosen" because in science random is completely
19 different than this exercise. So, again, these points
20 were just randomly navigated to very quickly With
21 Deputy Thompson.

22 Q. Right. But it wasn't random in like a
23 statistical sense of choosing a random sample, like a
24 statistically significant random sample dataset?

25 A. Correct. You're correct. Yes. This was

1 W. Funderburk

2 not a random subset of this data. However, you know,
3 given that all this -- the geocoding process was done
4 in a batch, as a batch process, there's no reason to
5 think or believe that these are isolated incidents
6 from the rest of the dataset.

7 Q. But to actually determine that would require
8 additional analysis of additional data points?

9 MR. NOBILE: Objection, form.

10 A. To determine what?

11 Q. To determine whether there were
12 additional -- to determine whether additional -- there
13 were in fact additional errors, errors as defined by
14 the process you used, you would have to analyze
15 additional data points?

16 A. Not necessarily. I don't need to analyze
17 additional data points, again, because these were all
18 done in one batch process. And, now, the number of
19 roadblocks that occur in these few exhibits is
20 approximately 12 percent of the total roadblocks in a
21 compiled unique roadblock dataset. So if we were to
22 sample it statistically, 10 percent of the population
23 data would be represented here. And by population, I
24 don't mean people. In stats there's a sample
25 population that you take to represent a target

1 W. Funderburk

2 "Given that the geographic analyses are the premise to
3 the statistical argument, the statistical analyses is
4 invalid as well."

5 When you are offering that opinion that the
6 statistical analyses are invalid, are you offering
7 that as an expert in statistical analysis?

8 A. No, sir, I'm not. I've had enough
9 mathematics and taken mathematical logic courses.
10 Given that the premise to any argument -- if the
11 premise to the argument is invalid, thus the argument
12 is invalid. That's classical logic as well as
13 mathematical logic. And you take that when you take
14 number theory course work.

15 Q. But you didn't do any statistical analysis
16 that would confirm or refute Dr. Ricchetti's
17 statistical analysis?

18 A. No, sir. I wasn't paid to do any
19 statistical analysis here. Again, that's just
20 classical mathematical logic.

21 MR. RETHY: That's all I've got.

22 EXAMINATION

23 BY MR. NOBILE:

24 Q. Okay. Just a few followup questions.
25 Mr. Funderburk, can you go to Exhibit 12 of your

1 W. Funderburk
2 location information and assign fine, precise geodetic
3 coordinates to it.

4 MR. NOBILE: No further questions.

5 MR. RETHY: All right. We're done.

6 (THE DEPOSITION OF WILLIAM FUNDERBURK
7 WAS CONCLUDED AT 3:34 P.M.)

8
9 _____
10 WILLIAM FUNDERBURK
11

12 Subscribed and sworn to before me
13 this _____ day of _____ 2018.
14

15 _____
16 (Notary Public)

_____ My Commission Expires:
17
18
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20
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22
23
24
25

W. Funderburk
C E R T I F I C A T E

I do hereby certify that the foregoing proceedings were taken down by me and transcribed using computer-aided transcription and that the foregoing is a true and correct transcript of said proceedings.

I further certify that I am neither of counsel nor of kin to any of the parties, nor am I in anywise interested in the result of said cause.

I further certify that I have earned the certifications awarded by the National Court Reporters Association of RPR,RMR,RDR,CRR,CRC,RSA and am duly licensed by the Alabama, Illinois, Louisiana and Mississippi Boards of Court Reporting as a Certified Court Reporter.

DATED: JUNE 25, 2018

DEBRA AMOS ISBELL, CCR,RDR,CRR
ALABAMA - ACCR #21 (expires 9/30/18)
ILLINOIS - CSR #084.004798 (expires 5/31/19)
LOUISIANA - CCR #2014003 (expires 12/31/18)
MISSISSIPPI - CSR #1809 (expires 4/10/19)
NCRA (expires 12/31/2018)